



September 13, 2019

Mr. McKenzie Mallary  
Remedial Project Manager  
U.S. Environmental Protection Agency, Region 4  
Atlanta Federal Center  
61 Forsyth Street SW Suite 9T25  
Atlanta, Georgia 30303

**Re: Thirty-Fifth DNAPL Removal Report  
December 2018 through May 2019  
SCE&G - Calhoun Park Area Site  
Charleston, South Carolina**

Dear Mr. Mallary:

On behalf of Dominion Energy South Carolina, Inc. (DESC), Apex Companies, LLC (Apex) is submitting the following DNAPL Removal Report for the Calhoun Park Area (CPA) site located in Charleston, South Carolina. The intent of this report is to summarize the on-going dense non-aqueous phase liquid (DNAPL) removal activities, evaluate the effectiveness of the program and discuss future activities. This summary represents the 35th report to be submitted as specified in the Site-Wide DNAPL Removal Work Plan (SWDRWP) approved on June 5, 2002. For this winter reporting period, DNAPL removal information is presented from December 2018 through May 2019. A total of 40,615 gallons of DNAPL has been removed since October 1998 as summarized on Table 1.

## **DNAPL REMOVAL OVERVIEW**

The DNAPL removal activities outlined in the SWDRWP involved the following major elements:

- Removal from DNAPL recovery wells (DRW wells) located within the collection trenches installed during excavation activities;
- Automated recovery from DRW-06 located in the former gas holder; and
- Recovery from groundwater monitoring wells and other DRW wells where DNAPL typically accumulates.

It is important to note that most of the DNAPL removal activities addressed in this report are related to the DRW wells installed in the collection trenches and the former gasholder. Typically, DRW wells were constructed using an 8-inch inside diameter (ID) well screen installed within a stone-filled trench. DRW wells have also been installed in the former gasholder and two other site areas where deeper DNAPL removal was targeted in the middle intermediate sand unit. In addition to the DRW wells, DNAPL is periodically removed from a limited number of shallow and middle intermediate sand unit groundwater monitoring wells, which constitute a much smaller volume of the total DNAPL recovered. Also, the terms "removal" and "recovery" are used interchangeably to describe the DNAPL pumping process.

DNAPL is removed using positive displacement and peristaltic pumps. An automated electric positive



displacement pump is located in DRW-06 and set to pump at defined intervals. Currently, seven DRW wells (DRW-12, -13, -32, -33, -34, -35, and -38) are equipped with “downhole” well assemblies that utilize a pneumatic, positive displacement pump to actuate a piston that results in DNAPL evacuation. The pneumatic pump is portable and cycled between wells after sufficient DNAPL accumulates. The PeriFlo peristaltic pumps are also utilized to remove DNAPL from several DRW and monitoring well locations.

The current DNAPL removal schedule typically consists of a two-week on-site removal period followed by a one-week non-pumping period to allow for DNAPL recharge. This schedule has proven effective in increasing the efficiency of the DNAPL removal program.

## **DNAPL REMOVAL SUMMARY**

The progress reports submitted to the agencies provide routine information regarding the total quantity of DNAPL removed. Approximately 1,121 gallons of DNAPL were removed during this reporting period (December 2018 through May 2019) with the majority removed from DRW-06 (approximately 903 gallons) located in the gasholder and the trench DNAPL recovery wells (about 206 gallons). Significant DNAPL recovery volume from DRW-06 continued during this reporting period. Table 1 provides total and monthly average DNAPL recovered since the program's inception. Figure 1 shows the removal locations and Table 2 provides monthly and cumulative totals for each well where DNAPL was removed.

### **DNAPL Recovery Trenches and Monitoring Wells**

During the December 2018 through May 2019 reporting period, the volume of DNAPL removed from the trenches and shallow and intermediate wells fell within the expected downward trend. Excluding the Segment 7 gasholder wells (DRW-02, -06, and -07), a total of about 218 gallons of DNAPL was removed with approximately 95% of the total from the DRW trench wells and about 5% from the shallow and intermediate monitoring wells. This ratio is similar to previous reporting period ratios (typically 95 to 97% and 3 to 5%). The highest quantity removed (82.0 gallons) was from Segment 6 (southeast substation) and the least (10.4 gallons) was from Segment 4 (north substation), as shown on Figure 1.

From the beginning of the DNAPL removal program through November 2012, the highest volume removed from trench wells occurred at Segment 2, located in the south-central portion of the substation. From December 2012 through November 2014, the highest DNAPL volume removed alternated between Segment 2 (summer periods) and Segment 6 (winter periods). Over the last eight reporting periods, the highest volume removed has occurred at Segment 6. This data suggest DNAPL volume in Segment 2 continues to diminish while at Segment 6 DNAPL volume has diminished at a slower rate (Attachment C). Segment 6 DNAPL volume removed has been variable but range bound since the November 2013 reporting period, with the winter 2019 volume (82.0 gallons) similar to the winter 2018 volume (81.9 gallons).

Figure 2 provides a graphical illustration of DNAPL recovery at trench Segments 1 through 6, which shows the volume recovered during each reporting period and recovery trends. As can be noted on Figure 2, the volume recovered during this reporting period from five of the six trench segments (1, 3, 4, 5 and 6) fell within the lower end of their recent respective historical ranges. Segment 2 had the lowest volume removed during a reporting period since the DNAPL removal program was initiated in 2002. Data from this reporting period continues to yield an asymptotic DNAPL removal response at Segments 1 through 6, which suggests that the DNAPL removal program continues to achieve its primary objective.

For the DRW wells, the highest quantity of DNAPL was removed from DRW-21 (41.5 gallons) and DRW-08 (31.5 gallons) in Segment 6 and DRW-42 (19.75 gallons) in Segment 3. With respect to the shallow and intermediate wells, intermediate well MM-02B yielded the highest volume removed (8.5 gallons). The volume removed from the shallow wells was greater than one gallon (1.85 gallons), which is the highest volume removed from the shallow wells since the December 2013 through May 2014 reporting period. Attachment D provides an update on removal activities at shallow well MW-12A, located east of Concord Street on National Park Service property, and includes monthly apparent DNAPL thickness measurements and volume removed.

### **DRW-06**

DRW-06 is located in the former gasholder (Figure 1). The former gasholder is a circular structure with walls constructed of 1-inch thick steel and cemented brick, a wooden floor and an interior filled with debris and soil. The well screen for DRW-06 is extended through the former gasholder floor to optimize recovery (i.e., well is sumped). The bottom of the former gasholder is set on a clay (i.e., Upper Clay), which is believed to provide a low hydraulic conductivity (K) layer to the downward migration of DNAPL. With respect to DNAPL, the former gasholder is believed to be a closed system with DNAPL not migrating into or out of the structure.

DNAPL removal from DRW-06 may be summarized as peak production from 2002-2009, followed by relatively stable volume decreases, similar to the trench recovery curves. However, an increase in DNAPL volume removed was first identified in the June through November 2013 reporting period and has been followed by sustained increases through this reporting period (Figure 4). The DNAPL volume removed from DRW-06 this reporting period (903 gallons) fell within the recent historical range. Figure 3 shows DRW-06 historical DNAPL volume removed and apparent thickness, and since October 2013 shows how both variables have increased. This period shows relatively consistent recovery during the first three months, followed by notable variability in the last three months. The variability is due primarily to the variable number of recovery days in those months. Figures 2 and 4 show DRW-06 DNAPL recovery volume over time and further illustrate increased recovery since October 2013 with removal volumes ranging from about 750 to 1,000 gallons since the May 2014 reporting period. The decreasing trend starting in May 2015 is attributed to the May 2015 winter period representing the maximum volume removed from DRW-06. Interestingly, the apparent DNAPL thickness (in feet) for DRW-06 has maintained a steady state condition since May 2014.

DRW-06 appears to be situated at a location within the former gasholder where DNAPL flows preferentially and the sustained automated operation of the positive displacement pump creates conditions suitable for continuous DNAPL recovery. The pump settings were maintained to activate every 1.5-hours with a 4-minute pumping duration or about 64 minutes of daily run time. Adjustments to the pump operating parameters will be considered, as needed, in response to changes in the DNAPL recovery observations.

### **CURRENT ASSESSMENT**

Attachment C provides a discussion of the current trend evaluations being conducted to monitor the on-going removal operations and the overall effectiveness of the program. Supporting data in the form of tables and graphs are provided for review. The following assessment summarizes the current understanding of the DNAPL removal program and uses data and information from the most recent and historical events:

- This winter reporting period (December 2018 through May 2019) had 1,121 gallons removed, which is significantly more than the 2013, less than the 2015 and 2017, and similar to or more than the 2014, 2016 and 2018 winter periods (Table 1 and Figure 5);
- The overall DNAPL volume removed falls within the range of the previous 10 reporting periods and is primarily attributed to increased production from DRW-06 (Figures 5 and 6). DRW-06 DNAPL recovery volume started to increase in October 2013 and has sustained at a higher level through this recovery period (Figure 4);
- The volume removed from DRW-06 (about 903 gallons) accounted for about 81% of the total volume removed during this reporting period and was approximately 7.5 times greater than its average from 2005 until October 2013 (120 gallons);
- The automated recovery pump within DRW-06 has been highly effective and will continue to be evaluated/adjusted to maximize removal operations. Based on Figure 3, it appears that the current pump settings continue to be appropriate as the monthly volume of DNAPL removed and apparent thickness of product remaining in DRW-06 remain consistent;
- Trench segments 2, 5, and 6 continue to yield the highest DNAPL volume recovered during this reporting period (Figure 1);
- Since the December 2014 through May 2015 reporting period, Segment 6 has yielded the highest DNAPL volume removed and was maintained during this reporting period;
- Segments 1 through 6 show an asymptotic response with slight variability common between recovery periods;
- Excluding DRW-06, the average volume removed was 0.94 gallons per event, which is below the mean of the average volume removed (1.01 gallons per event) for the last 11 winter reporting periods since May 2008 but within the range for this period of time. Maintaining removal within the range over this period of time is attributed to maximizing DNAPL removal efficiency with a diminishing DNAPL source within the trench segments;
- Trench segment DNAPL removal seasonal variability is noted (oscillatory peak and valley pattern) between the summer and winter removal periods and is attributed to DNAPL viscosity changes from seasonal temperature changes. With time, volume removal differences between removal periods has lessened (Table 3 and Figure 2);
- The two-week removal and one-week recovery period has been effective in maximizing available DNAPL removal while reducing labor and overall site costs; and
- The primary objective of the Record of Decision (ROD), DNAPL removal to the maximum extent practicable, continues to be achieved.

## RECYCLING

Recovered DNAPL is contained in 55-gallon drums, temporarily staged on site, and periodically transported to a pre-approved facility for recycling. Tradebe Treatment and Recycling of Tennessee, LLC (Tradebe) [formerly known as PCI] located in Millington, Tennessee was approved by the U.S. EPA on March 6, 2006 as the recycling facility. The Millington facility receives shipments of DNAPL in drums and recycles the material or transfers the DNAPL to the Tradebe East Chicago facility for recycling, generally depending on the viscosity of the DNAPL within each drum.

For this reporting period, 20 drums of recovered DNAPL were transported to Tradebe for recycling on February 15, 2019 (Attachment E). From October 2000 through May 2019, a total of 775 drums have been transported to recycling facilities (Table 4).

## SUMMARY AND RECOMMENDATIONS

Through May 31, 2019 approximately 40,615 gallons of DNAPL have been removed from the CPA site through manual removal and operation of the DNAPL recovery systems. These efforts have supplemented the DNAPL removal accomplished during the previous removal actions documented in the Interim Remedial Action Report for Operable Unit #1 (MTR, August 2006). Those removal actions involved approximately 49,000 tons of material (excluding debris) and over 3.1 million gallons of fluids, resulting in the removal of significant volumes of DNAPL from the CPA site.

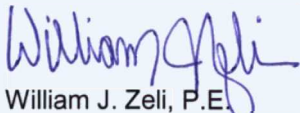
Manual DNAPL removal has been effective in removing a large mass of DNAPL from the subsurface and it is recommended that removal activities be continued. As demonstrated by the information contained herein, the overall trends continue to show decreasing to flattening DNAPL recovery with time indicating that the total volume of DNAPL is being depleted. Therefore, efforts will continue (i.e., pumps will be moved and recovery activities will be evaluated) to maximize DNAPL recovery while maintaining the current DNAPL removal schedule.

Monitoring for DNAPL accumulation within wells at the site will continue as part of the removal program. DNAPL monitoring measurements for the December 2018 through May 2019 period are provided in Attachment F. Table 5 provides the planned DNAPL monitoring schedule for the reporting period beginning December 2019. Changes to the current monitoring program include:

- Adjustment to the monitoring frequency for some locations, as identified in Table 5; and
- Addition of wells to the annual DNAPL monitoring program, if approved for removal from the list of wells for annual shallow groundwater level measurements.

The next DNAPL report will include data from June 2019 through November 2019. Should you have any questions, please contact Tom Effinger at (803) 217-9367 or me at (412) 829-9650.

Sincerely,  
**Apex Companies, LLC**



William J. Zeli, P.E.  
Senior Program Manager

### Attachments

- A Tables
- B Figures
- C DNAPL Removal Evaluations
- D MW-12A DNAPL Measurements and Pumping Activity
- E Recycling Manifest
- F DNAPL Monitoring Measurements – December 2018 through May 2019

cc: J. Padgett, SCDHEC  
T. Effinger, P. Biery, R. Contrael – DESC (via e-mail)

## **ATTACHMENT A**

### **TABLES**

Table 1	Cumulative Total – October 1998 through May 2019
Table 2	Summary of DNAPL Removed – December 2018 through May 2019
Table 3	Average Gallons Removed Per Removal Event – August 2002 through May 2019
Table 4	Summary of DNAPL Shipments – January 2000 through May 2019
Table 5	Apparent DNAPL Thickness Monitoring Schedule



**TABLE 1**  
**CUMULATIVE TOTAL**  
**OCTOBER 1998 THROUGH MAY 2019**

**DESC Calhoun Park Area Site**  
**Charleston, South Carolina**

Time Period	Duration (months)	Gallons Recovered <sup>(1)</sup>	Reporting Period Average Per Month (gallons)
October 1998 - February 28, 2001	28	1,320	47.1
March 1, 2001 - February 28, 2002	12	683	56.9
March 1, 2002 - August 30, 2002	6	2,356	392.5
September 1, 2002 - November 30, 2002	3	1,325	441.7
December 1, 2002 - May 31, 2003	6	1,884	314.0
June 1, 2003 - November 30, 2003	6	2,415	402.5
December 1, 2003 - May 31, 2004	6	1,929	321.5
June 1, 2004 - November 30, 2004	6	2,018	336.3
December 1, 2004 - May 31, 2005	6	1,334	222.4
June 1, 2005 - November 30, 2005	6	1,725	286.7
December 1, 2005 - May 31, 2006	6	1,345	224.1
June 1, 2006 - November 30, 2006	6	1,309	218.1
December 1, 2006 - May 31, 2007	6	966	161.0
June 1, 2007 - November 30, 2007	6	1,025	170.8
December 1, 2007 - May 31, 2008	6	653	108.8
June 1, 2008 - November 30, 2008	6	644	107.4
December 1, 2008 - May 31, 2009	6	465	77.6
June 1, 2009 - November 30, 2009	6	600	100.1
December 1, 2009 - May 31, 2010	6	418	69.7
June 1, 2010 - November 30, 2010	6	540	90.0
December 1, 2010 - May 31, 2011	6	396	66.0
June 1, 2011 - November 30, 2011	6	486	80.9
December 1, 2011 - May 31, 2012	6	403	67.2
June 1, 2012 - November 30, 2012	6	512	85.4
December 1, 2012 - May 31, 2013	6	413	68.9
June 1, 2013 - November 30, 2013	6	613	102.1
December 1, 2013 - May 31, 2014	6	1,020	170.0
June 1, 2014 - November 30, 2014	6	1,200	200.0
December 1, 2014 - May 31, 2015	6	1,252	208.7
June 1, 2015 - November 30, 2015	6	1,242	207.0
December 1, 2015 - May 31, 2016	6	1,135	189.1
June 1, 2016 - November 30, 2016	6	1,209	201.5
December 1, 2016 - May 31, 2017	6	1,204	200.7
June 1, 2017 - November 30, 2017	6	1,238	206.3
December 1, 2017 - May 31, 2018	6	1,068	178.1
June 1, 2018 - November 30, 2018	6	1,146	191.0
December 1, 2018 - May 31, 2019	6	1,121	186.9
<b>Total</b>		<b>40,615</b>	

**Notes:**

(1) Gallons recovered are based on volume measured in drums used to store DNAPL during removal operations.

**TABLE 2**  
**SUMMARY OF DNAPL REMOVED**  
**DECEMBER 2018 THROUGH MAY 2019**

DESC Calhoun Park Area Site  
Charleston, South Carolina

Well	DNAPL Volume Removed (gallons)							Removal Frequency Per Month							Average Gallons Removed Per Event by Month <sup>(1)</sup>						Average Removed Per Event (gallons) <sup>(2)</sup>
	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Total	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	Total	Dec-18	Jan-19	Feb-19	Mar-19	Apr-19	May-19	
DRW-06	120.95	199.37	106.71	165.73	152.73	157.06	902.55	Automated							Automated						Automated
DRW-08	3.50	7.75	3.25	7.00	5.50	4.50	31.50	3	8	4	6	6	4	31	1.17	0.97	0.81	1.17	0.92	1.13	1.02
DRW-12	1.50	1.75	1.00	2.75	1.75	2.15	10.90	1	2	2	3	2	3	13	1.50	0.88	0.50	0.92	0.88	0.72	0.84
DRW-13	0.75	3.25	0.15	0.75	3.25	1.50	9.65	1	3	1	2	2	2	11	0.75	1.08	0.15	0.38	1.63	0.75	0.88
DRW-14	0.50	0.75	0.00	0.00	1.75	0.50	3.50	1	1	0	0	2	1	5	0.50	0.75	0.00	0.00	0.88	0.00	0.70
DRW-15	1.25	1.00	0.75	0.75	0.25	1.50	5.50	1	1	1	2	1	2	8	1.25	1.00	0.75	0.38	0.25	0.75	0.69
DRW-16	2.00	0.50	1.00	0.35	0.75	0.50	5.10	1	1	1	1	1	1	6	2.00	0.00	1.00	0.00	0.00	0.00	0.85
DRW-18	0.00	0.20	0.00	0.00	0.00	0.00	0.20	0	1	0	0	0	0	1	0.00	0.20	0.00	0.00	0.00	0.00	0.20
DRW-19	0.25	2.25	0.50	2.00	0.50	2.00	7.50	1	2	1	2	1	2	9	0.25	1.13	0.50	1.00	0.50	1.00	0.83
DRW-20	0.00	0.00	0.15	0.00	0.00	0.00	0.15	0	0	1	0	0	0	1	0.00	0.00	0.15	0.00	0.00	0.00	0.15
DRW-21	9.00	10.75	3.75	6.50	5.50	6.00	41.50	2	4	2	3	3	3	17	4.50	2.69	1.88	2.17	1.83	2.00	2.44
DRW-22	1.25	1.50	0.50	0.50	0.75	0.00	4.50	1	1	1	1	1	0	5	1.25	0.00	0.50	0.00	0.75	0.00	0.90
DRW-23	0.00	0.00	0.75	0.00	0.00	0.00	0.75	0	0	1	0	0	0	1	0.00	0.00	0.00	0.00	0.00	0.00	0.75
DRW-24	0.25	0.00	0.25	0.25	0.00	0.50	1.25	1	0	1	1	1	1	5	0.25	0.00	0.00	0.00	0.00	0.00	0.25
DRW-25	0.75	0.00	0.75	0.00	0.00	0.50	2.00	1	0	1	0	0	1	3	0.75	0.00	0.75	0.00	0.00	0.50	0.67
DRW-26	0.00	0.00	0.50	0.00	0.00	0.00	0.50	0	0	1	0	0	0	1	0.00	0.00	0.00	0.00	0.00	0.00	0.50
DRW-28	1.50	0.50	0.00	0.00	0.00	0.50	2.50	1	1	0	0	0	1	3	1.50	0.00	0.00	0.00	0.00	0.00	0.83
DRW-30	0.00	0.00	0.25	0.00	0.00	0.00	0.25	0	0	1	0	0	0	1	0.00	0.00	0.00	0.00	0.00	0.00	0.25
DRW-32	0.25	1.25	1.75	0.00	0.75	0.75	4.75	1	3	1	0	1	1	7	0.25	0.42	1.75	0.00	0.75	0.75	0.68
DRW-33	2.50	2.25	0.00	3.00	0.75	2.25	10.75	1	2	0	3	1	2	9	2.50	1.13	0.00	1.00	0.75	1.13	1.19
DRW-34	1.50	0.75	1.15	1.25	2.25	2.00	8.90	1	2	3	3	4	2	15	1.50	0.38	0.38	0.42	0.58	1.00	0.59
DRW-35	4.00	3.25	0.00	2.75	2.50	0.00	12.50	1	1	0	1	2	0	5	4.00	3.25	0.00	2.75	1.25	0.00	2.50
DRW-36	0.00	0.10	0.10	0.00	0.00	0.10	0.30	0	1	1	0	0	1	3	0.00	0.10	0.10	0.00	0.00	0.00	0.10
DRW-37	0.00	1.00	0.25	0.00	0.00	0.75	2.00	0	1	1	0	0	1	3	0.00	0.00	0.00	0.00	0.00	0.00	0.67
DRW-38	0.50	0.00	0.00	0.15	0.25	0.00	0.90	1	0	0	1	1	0	3	0.00	0.00	0.00	0.00	0.25	0.00	0.30
DRW-39	1.00	0.00	0.50	0.00	0.25	0.50	2.25	1	0	1	0	1	1	4	1.00	0.00	0.50	0.00	0.00	0.00	0.56
DRW-40	0.00	0.00	0.25	0.00	0.00	0.00	0.25	0	0	1	0	0	0	1	0.00	0.00	0.00	0.00	0.00	0.00	0.25
DRW-41	0.00	2.35	0.00	0.00	0.00	0.00	2.35	0	2	0	0	0	0	2	0.00	0.00	0.00	0.00	0.00	0.00	1.18
DRW-42	5.00	3.50	1.50	3.50	2.75	3.50	19.75	6	4	2	5	3	3	23	0.83	0.88	0.75	0.70	0.92	1.17	0.86
DRW-47	0.00	0.00	0.50	0.00	0.00	0.00	0.50	0	0	1	0	0	0	1	0.00	0.00	0.00	0.00	0.00	0.00	0.50
DRW-48	2.65	2.75	1.50	1.25	2.75	1.50	12.40	1	2	1	1	2	1	8	2.65	1.38	1.50	1.25	1.38	1.50	1.55
DRW-51	0.00	0.00	0.10	0.00	0.50	0.25	0.85	0	0	1	0	1	1	3	0.00	0.00	0.00	0.00	0.00	0.00	0.28
Totals:	160.85	248.77	127.88	198.48	185.48	188.81	1,108.25	28	43	32	35	36	34	208	1.43	1.10	0.66	0.94	0.91	0.93	0.99
Shallow Monitoring Wells																					
CM-03A	0.00	0.20	0.00	0.25	0.00	0.10	0.55	0	1	0	1	0	1	3	0.00	0.00	0.00	0.00	0.00	0.00	0.18
MW-12A	0.00	0.20	0.15	0.00	0.75	0.00	1.10	0	1	1	0	1	0	3	0.00	0.20	0.15	0.00	0.75	0.00	0.37
MZ-55A	0.00	0.00	0.10	0.00	0.00	0.10	0.20	0	0	1	0	0	1	2	0.00	0.00	0.10	0.00	0.00	0.10	0.10
Totals:	0.00	0.40	0.25	0.25	0.75	0.20	1.85	0	2	2	1	1	2	8	0.00	0.20	0.13	0.00	0.75	0.10	0.23
Intermediate Monitoring and DNAPL Recovery Wells																					
DRW-52C	0.00	0.00	0.75	0.00	0.00	1.25	2.00	0	0	1	0	0	1	2	0.00	0.00	0.75	0.00	0.00	1.25	1.00
MM-02B	1.00	2.00	1.00	1.50	1.50	1.50	8.50	2	4	2	3	3	3	17	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Totals:	1.00	2.00	1.75	1.50	1.50	2.75	10.50	2	4	2	3	3	3	17	0.50	0.50	0.88	0.50	0.50	0.92	0.62
Totals:	161.85	249.17	129.88	200.23	187.73	191.76	1,120.60	30	49	36	39	40	39	233							

**Notes:**

- (1) Calculated for the well based on monthly DNAPL volume removed divided by monthly removal frequency.  
(2) Calculated by total reporting period volume removed divided by total reporting period removal events. Excludes DRW-06 since this well is operated in the automated mode.



**TABLE 3**  
**AVERAGE GALLONS REMOVED PER REMOVAL EVENT**  
**AUGUST 2002 TROUGH MAY 2019**

DESC Calhoun Park Area Site  
Charleston, South Carolina

Period End Date	Gallons Recovered <sup>(1)</sup>	Removal Events <sup>(2)</sup>	Average Removal per Event (gallons)
August 2002 <sup>(3)</sup>	1,845	385	4.79
November 2002 <sup>(3)</sup>	922	165	5.58
May 2003 <sup>(3)</sup>	1,156	267	4.33
November 2003	1,356	320	4.23
May 2004	1,161	340	3.41
November 2004	1,330	412	3.22
May 2005	983	316	3.11
November 2005	1,377	416	3.30
May 2006	1,003	539	1.86
November 2006	1,059	460	2.52
May 2007	714	531	1.34
November 2007 <sup>(4)</sup>	783	482	1.62
May 2008 <sup>(4)</sup>	537	472	1.14
November 2008 <sup>(4)</sup>	557	428	1.30
May 2009 <sup>(4)</sup>	382	486	0.79
November 2009 <sup>(4)</sup>	497	422	1.18
May 2010 <sup>(4)</sup>	348	394	0.88
November 2010 <sup>(5)</sup>	452	320	1.41
May 2011	329	317	1.04
November 2011	424	302	1.40
May 2012	330	317	1.04
November 2012	422	280	1.51
May 2013	305	275	1.11
November 2013	342	271	1.26
May 2014	277	280	0.99
November 2014	309	262	1.18
May 2015	242	262	0.92
November 2015	295	258	1.14
May 2016	240	231	1.04
November 2016	315	251	1.25
May 2017	247	222	1.11
November 2017	282	241	1.17
May 2018	224	222	1.01
November 2018	253	213	1.19
May 2019	218	233	0.94

**Notes:**

All numbers are approximate.

- (1) Excludes recovery wells located in the former gas holder (DRW-02, -06 and -07), and after March 2003 DRW-32 since it is operated in a semi-automated mode, and monitoring wells.
- (2) Manual removal events for DRW trench wells (and DRW-32 until March 2003) only and until November 2006 when monitoring wells were included while DRW-02, -06, -07, and -32 were still excluded.
- (3) Includes DRW-32 since operated manually through March 2003 and includes gallons recovered and removal events. Automated operation began in April 2003 and subsequent date, gallons recovered and removal events were no longer included.
- (4) From November 2007 to May 2010, the gallons recovered and removal events begin to include the monitoring wells but still excludes DRW-02, 06, -07, and -32.
- (5) From June 2010 forward, includes monitoring wells and DRW-32 since operation of DRW-32 was converted from semi-automated to manual, but still excludes DRW-02, 06 and 07.

TABLE 4

**SUMMARY OF DNAPL SHIPMENTS  
JANUARY 2000 THROUGH MAY 2019**

**DESC Calhoun Park Area Site  
Charleston, South Carolina**

<b>Drum Shipment Dates and Locations</b>	<b>Number of Drums</b>
<b><i>ONYX Environmental Services:</i></b>	
January 27, 2000	24
January 24, 2002	13
May 13, 2002	15
July 12, 2002	13
September 9, 2002	18
October 28, 2002	16
November 9, 2002	18
January 16, 2003	12
May 1, 2003	23
July 28, 2003	23
October 16, 2003	19
November 18, 2003	25
February 26, 2004	19
June 16, 2004	16
November 9, 2004	30
March 14, 2005	21
June 21, 2005	14
September 28, 2005	26
November 7, 2005	24
<b>Total:</b>	<b>369</b>
<b><i>Pollution Control Industries (PCI)</i></b>	
April 6, 2006	22
November 14, 2006	14
February 8, 2007	21
January 24, 2008	30
February 24, 2009	18
March 3, 2009	6
<b>Total:</b>	<b>111</b>
<b><i>TRADEBE (PCI was acquired by Tradebe)</i></b>	
July 20, 2010	21
January 25, 2011	11
December 9, 2011	12
October 5, 2012	11
August 2, 2013	12
March 11, 2014	16
July 3, 2014	13
December 3, 2014	19
April 27, 2015	14
September 1, 2015	19
January 26, 2016	15
May 31, 2016	16
November 1, 2016	21
April 25, 2017	20
October 9, 2017	18
March 26, 2018	18
September 18, 2018	19
February 15, 2019	20
<b>Total:</b>	<b>295</b>
<b>Total Number of Drums:</b>	<b>775</b>

TABLE 5

## APPARENT DNAPL THICKNESS MONITORING SCHEDULE

DESC Calhoun Park Area Site  
Charleston, South Carolina

Well	Monitoring Frequency	Notes
DRW-06	Weekly	During removal operations
MM-02B	Weekly	During removal operations
CM-03A	Monthly	Continue monthly frequency
MW-12A	Monthly	Continue monthly frequency
DRW-52C	Quarterly	Change from monthly
DRW-53C	Quarterly	Change from monthly
MM-01B	Quarterly	Change from monthly
MM-11A	Quarterly	Change from monthly
DRW-48	Quarterly	Change from monthly
DRW-51	Quarterly	Change from monthly
A3-T3	Semi-annual	Change from quarterly
DRW-02	Semi-annual	Change from quarterly
DRW-08 and 09	Semi-annual	Change from quarterly
DRW-12 thru DRW-47	Semi-annual	Change from quarterly
DRW-49 and 50	Semi-annual	Change from quarterly
MZ-06M	Semi-annual	Change from quarterly
MZ-55A	Semi-annual	Change from monthly
ORC-7	Semi-annual	Change from quarterly
DRW-07	Annual	Change from quarterly
DRW-10	Annual	Continue annually
DRW-11	Annual	Continue annually
LM-10AR	Annual	Continue annually
MM-03A	Annual	Continue annually
MM-15C	Annual	Change from quarterly
MRW-05	Annual	Change from quarterly
MRW-03	Annual	If removal from annual shallow groundwater level measurement list is approved
MRW-04	Annual	
MRW-06	Annual	
MZ-06U	Annual	
PM-02A	Annual	
Shallow Monitoring Wells	Annual	See note 1
Intermediate Monitoring Wells	Annual	See note 2

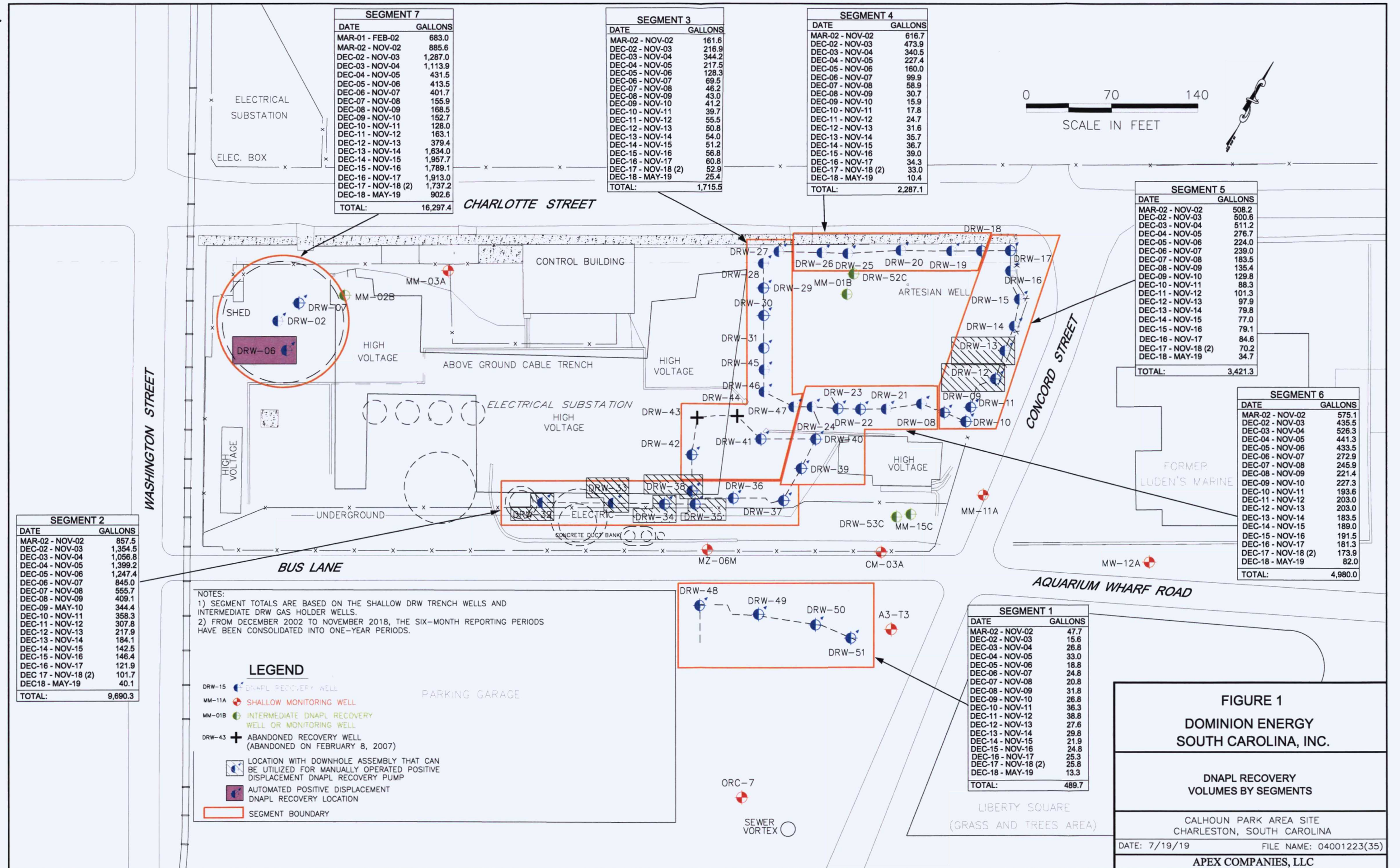
**Notes:**

- (1) Includes shallow monitoring wells in the current annual groundwater monitoring program.  
The next shallow groundwater monitoring event is planned in Second Quarter 2020.
- (2) Includes intermediate monitoring wells in the current annual groundwater monitoring program.  
The next intermediate groundwater monitoring event is planned in Fourth Quarter 2019.
- (3) Annual DNAPL monitoring planned in April 2020.

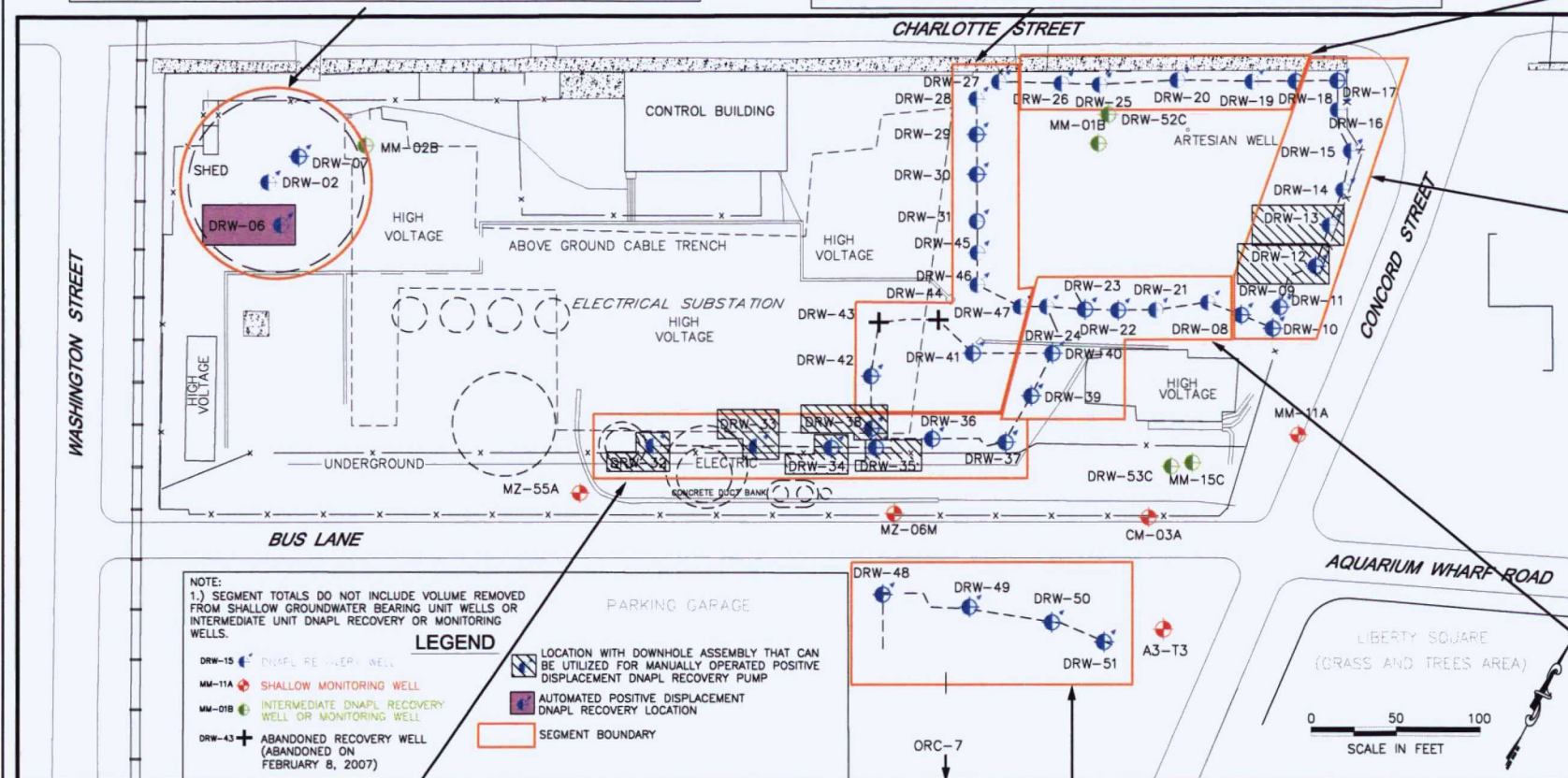
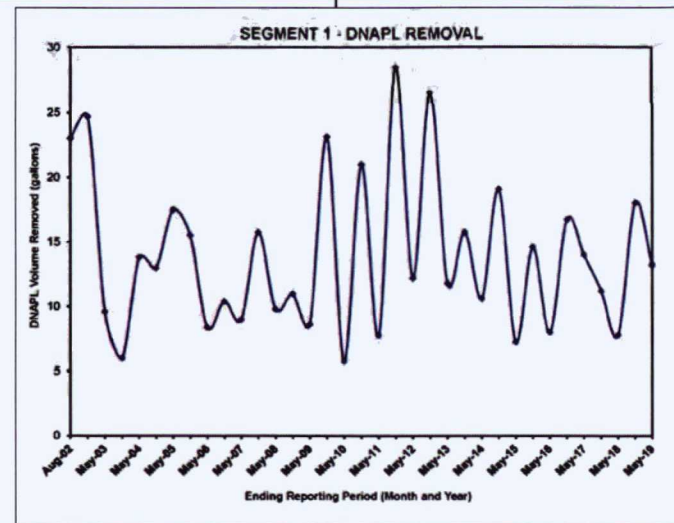
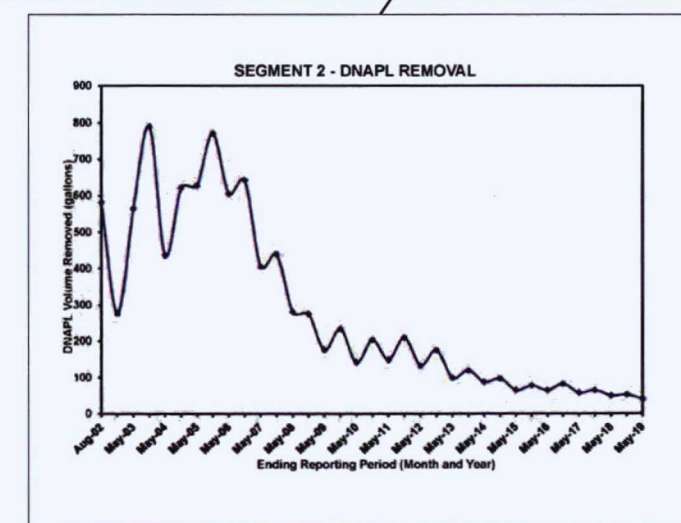
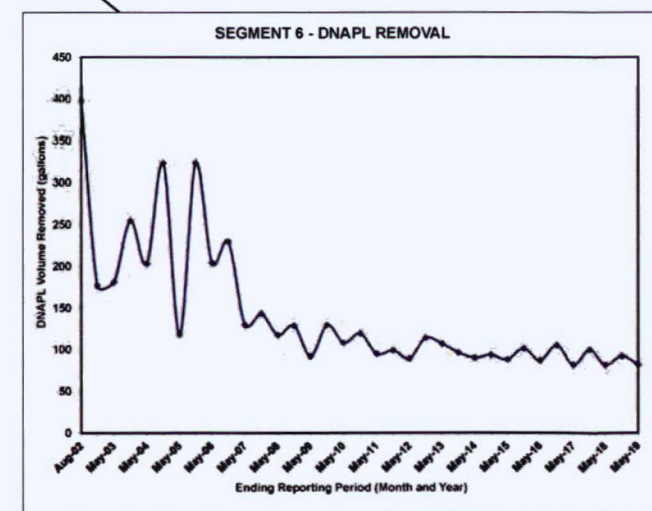
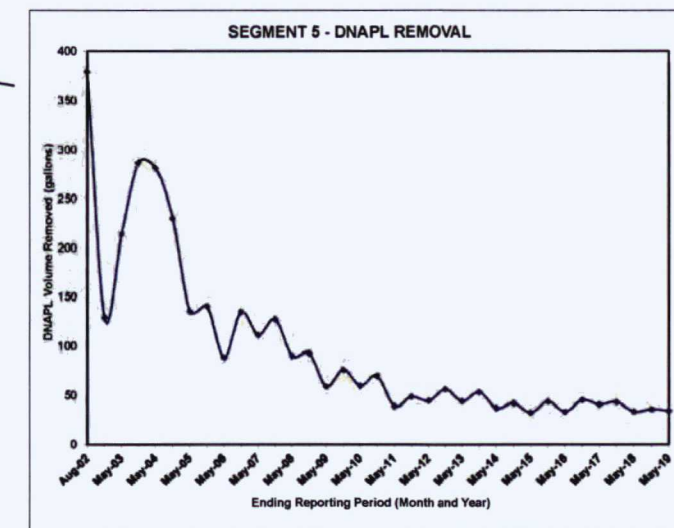
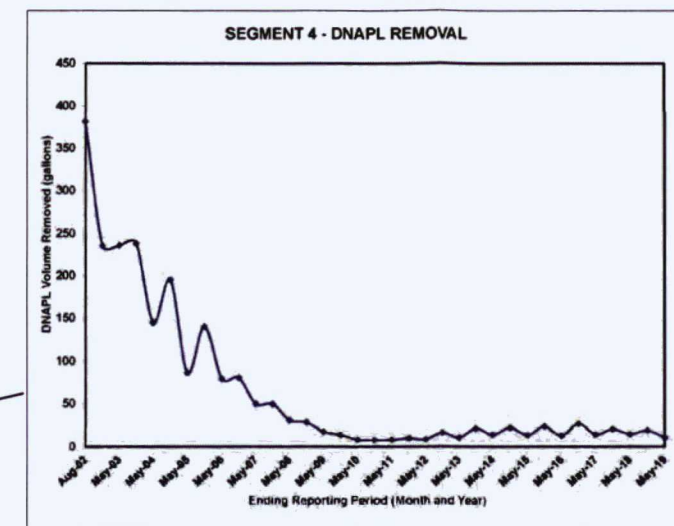
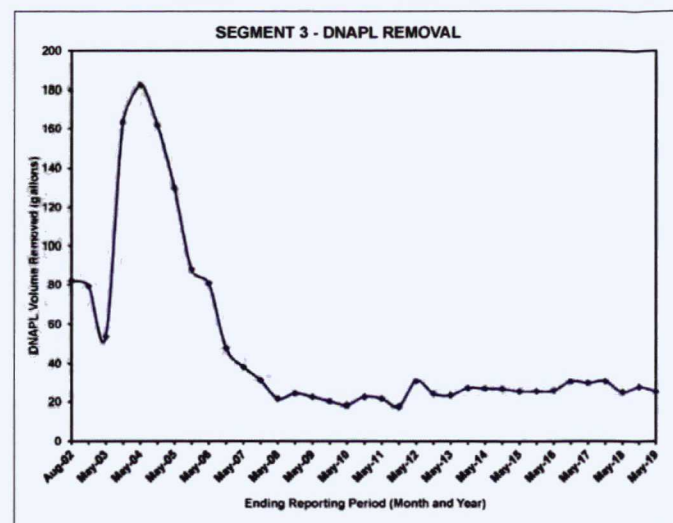
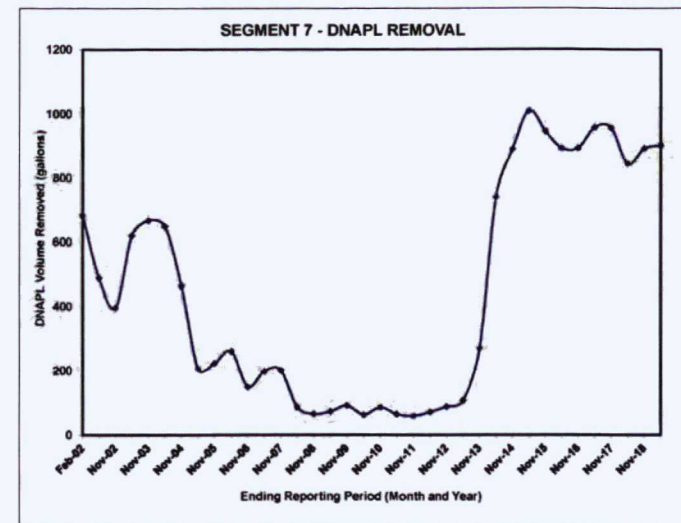
## **ATTACHMENT B**

### **FIGURES**

- Figure 1 DNAPL Recovery Volumes by Segments
- Figure 2 DNAPL Removal Trends with Time
- Figure 3 DRW-06 Historical Monthly Volume Removed and Apparent DNAPL Thickness
- Figure 4 DRW-06 Total DNAPL Volume Removed from March 2001 – May 2019
- Figure 5 Total Volume of DNAPL Removed During 6-Month Reporting Periods
- Figure 6 Total DNAPL Volume Removed by Month, March 2002 – May 2019







**FIGURE 2**  
**DOMINION ENERGY**  
**SOUTH CAROLINA, INC.**

**DNAPL REMOVAL**  
**TRENDS WITH TIME**

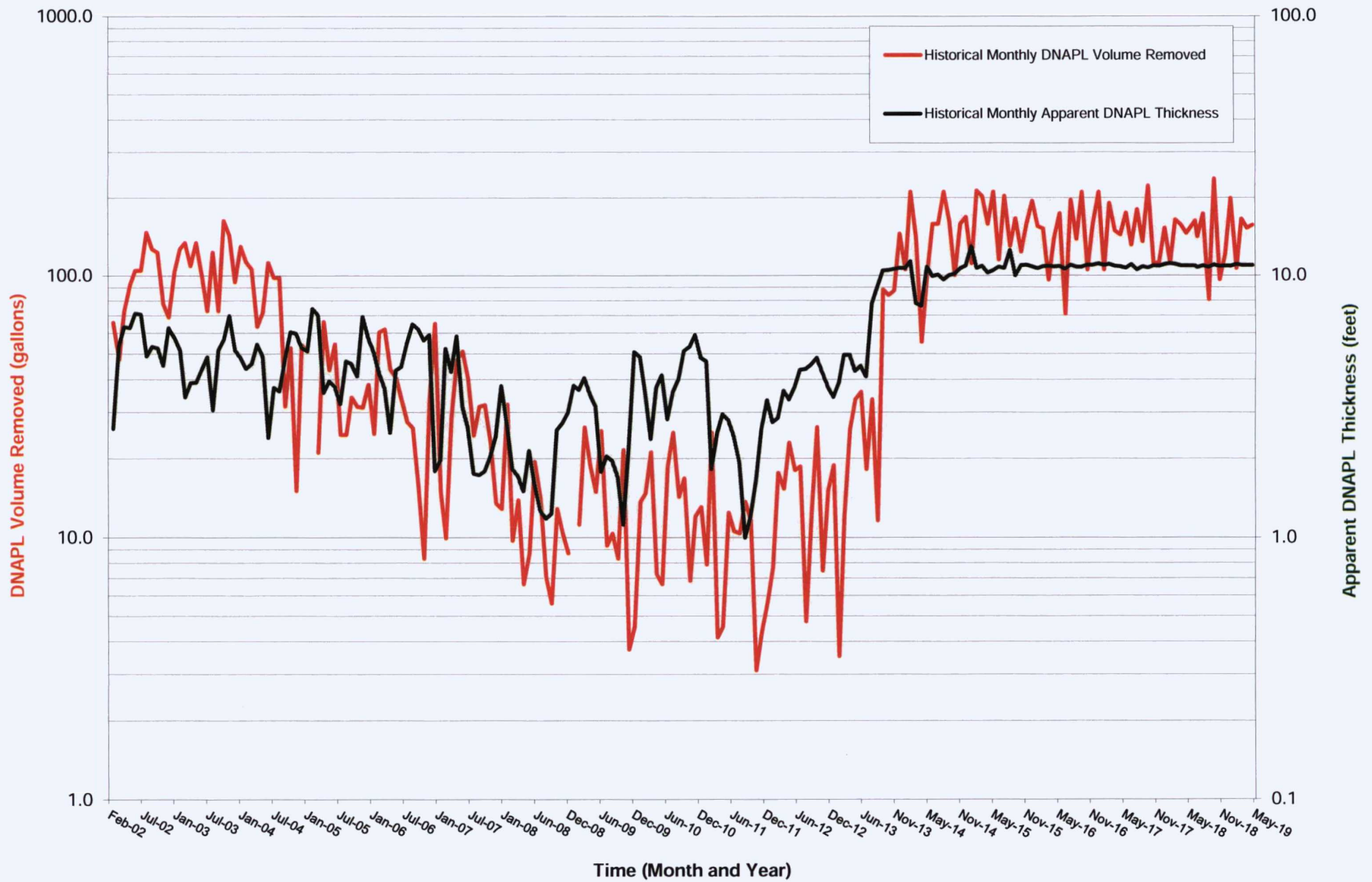
CALHOUN PARK AREA SITE  
CHARLESTON, SOUTH CAROLINA

DATE: 7/19/2019 FILE NAME: segmentplots35

APEX COMPANIES, LLC

FIGURE 3

DRW-06 Historical Monthly Volume Removed and Apparent DNAPL Thickness





DRW-06 MONTHLY DNAPL RECOVERY

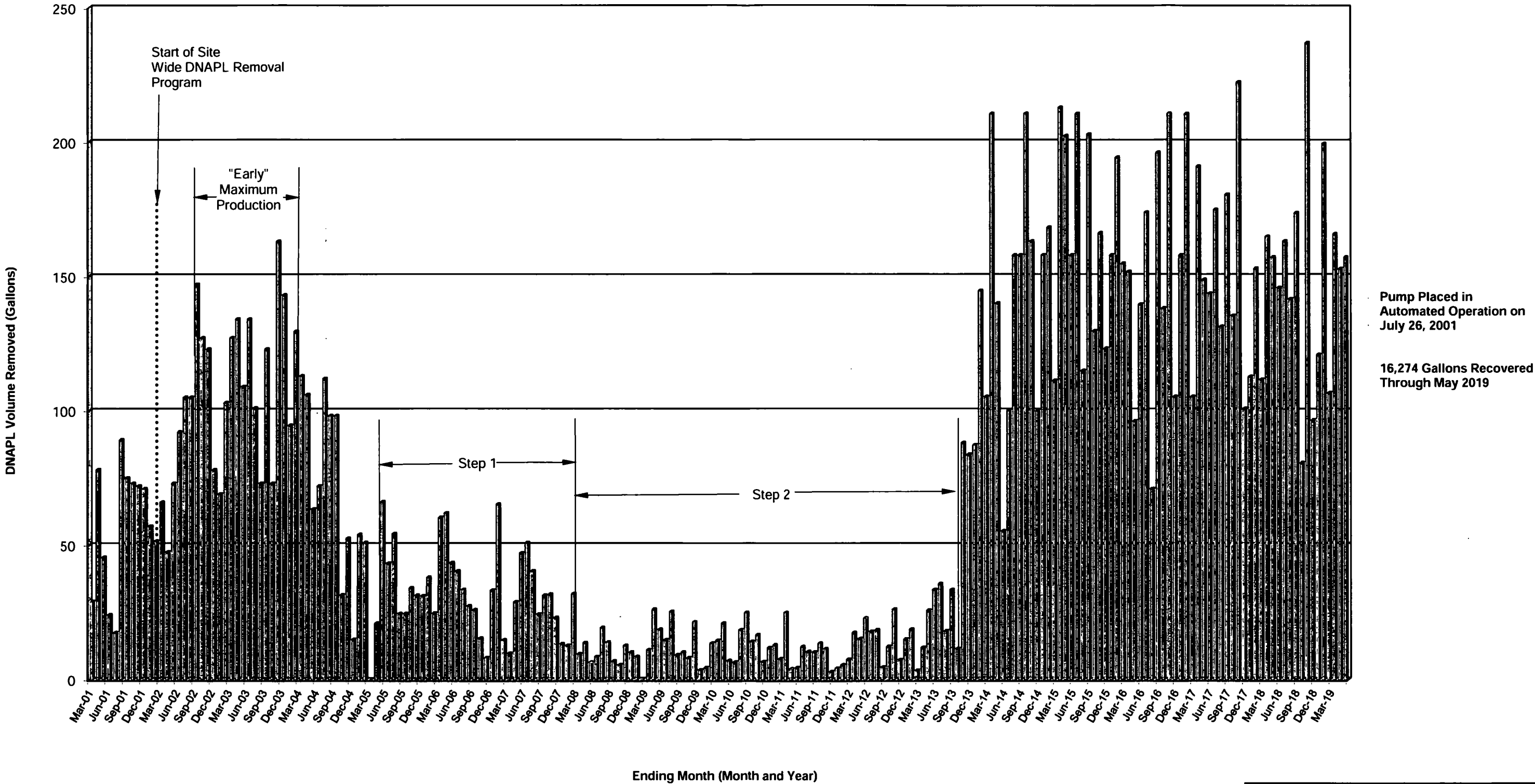
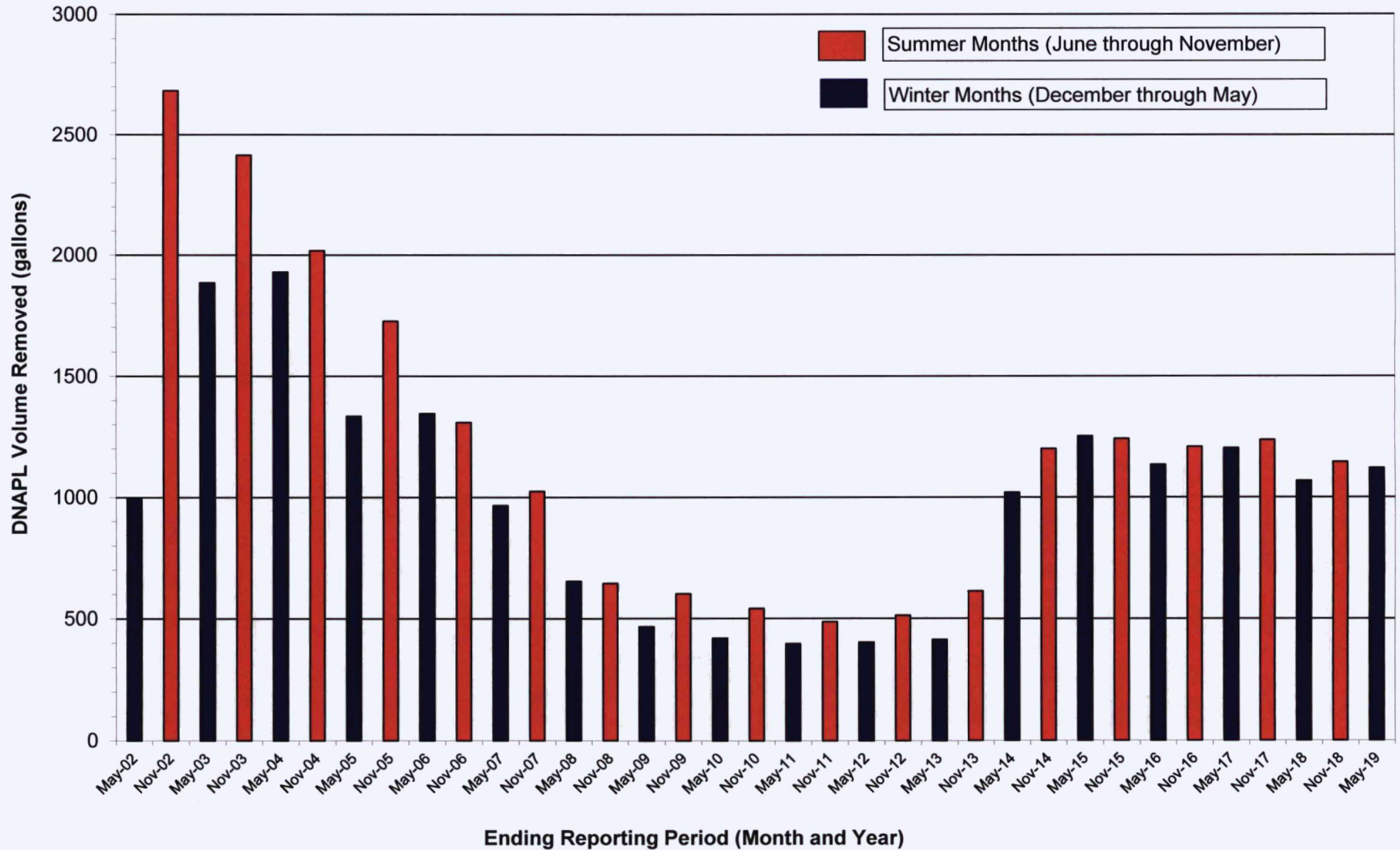


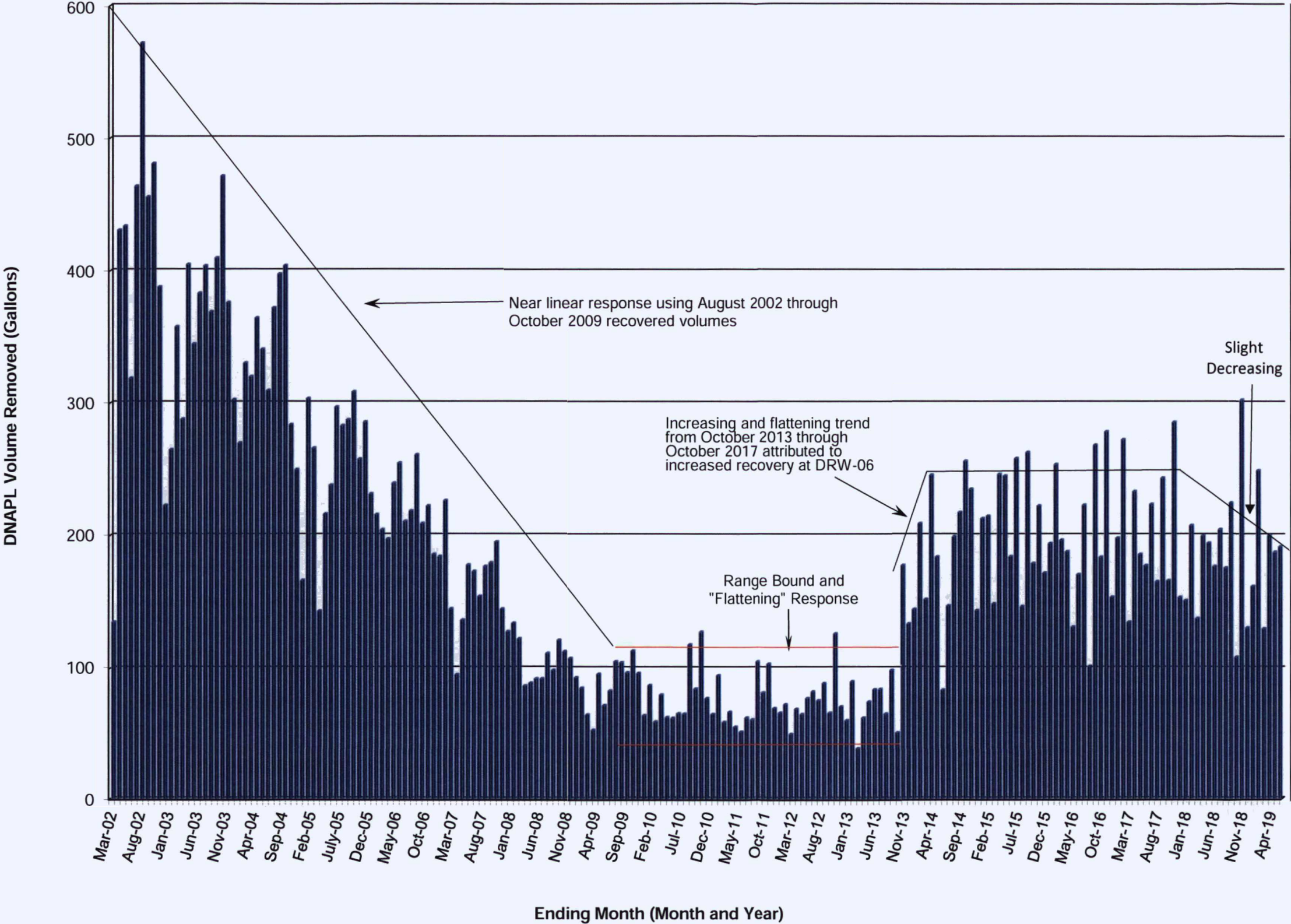
FIGURE 4  
SOUTH CAROLINA ELECTRIC & GAS CO.  
DRW-06 TOTAL DNAPL VOLUME REMOVED  
FROM MARCH 2001 - MAY 2019  
CALHOUN PARK AREA SITE  
CHARLESTON, SOUTH CAROLINA  
APEX COMPANIES, LLC

FIGURE 5

TOTAL VOLUME OF DNAPL REMOVED DURING 6-MONTH REPORTING PERIODS



TOTAL DNAPL VOLUME REMOVED BY MONTH



2,003 Gallons Recovered  
Prior to March 2002

38,612 Gallons Recovered  
Since March 2002 (Based on  
Drum Measurements)

40,615 Gallons Recovered  
Through May 2019

Note: The increased DNAPL  
volume removed from October  
2013 through May 2019 is  
attributed to the increased  
DNAPL recovery from DRW-06.

FIGURE 6  
SOUTH CAROLINA ELECTRIC & GAS CO.  
TOTAL DNAPL VOLUME REMOVED BY MONTH  
MARCH 2002 - MAY 2019  
CALHOUN PARK AREA SITE  
CHARLESTON, SOUTH CAROLINA  
APEX COMPANIES, LLC

**ATTACHMENT C**  
**DNAPL REMOVAL EVALUATIONS**



## ATTACHMENT C

### DNAPL REMOVAL EVALUATIONS: DECEMBER 2018 THROUGH MAY 2019

Previous DNAPL Removal Reports presented several methodologies to evaluate DNAPL removal data. The intent of the evaluation was to assess the various data to understand variables influencing DNAPL removal and make appropriate adjustments to cost effectively maximize DNAPL removal. This attachment was developed to briefly review historic data and discuss the recently collected data. In general, tables and figures used in previous DNAPL removal reports are maintained and updated with the most recent 6-month data. The results are briefly discussed below.

Table C-1 and Figure C-1 compare the average monthly DNAPL volume removed with the total number of removal events in order to arrive at a metric that is intended to quantify removal efficiency. The metric is calculated using the average monthly volume removed for the reporting period divided by the total number of removal events for the period. A higher metric value indicates more efficient DNAPL removal and a lower metric value indicates less efficient removal. The metric for the winter 2019 period is 0.80, which falls within the range of the last nine reporting periods (winter and summer) and coincides with increased DNAPL recovery from DRW-06. The average volume removed per removal event (0.94 gallons) for this period was within the historical range starting with the May 2008 reporting period (Figure C-2). In general, the averages between reporting periods are similar (especially since May 2011), and the slight increases and decreases over multiple reporting periods can be attributed to periods of pooling and depletion as shown on Figure C-3a.

The Decay Model was introduced in the Thirteenth DNAPL Removal Report (MTR, February 2009) and was based on DNAPL recovered over time excluding recovery from the gasholder wells (DRW-02, -06, and -07). The base form of the standard exponential decay equation was used for the Decay Model. Figure C-3a shows when winter period DNAPL volume removed is plotted against time, the exponential decay relationship is maintained, and the correlation is relatively high ( $R^2 = 0.90$ ). Figure C-3a shows three periods of "pooling" and three periods of "depletion" which are qualitatively identified and determined by a change in slope of DNAPL removed over time. Depletion periods range in duration from 2 to 4 years with the duration decreasing with time. Pooling ranged from 2 to 3 years with the last two pooling events having a duration of 2 years. Since the start of the previous depletion period in December 2011 through May 2012 (month 123) to this reporting period (December 2018 through May 2019), the volume removed on a winter basis has decreased by 112 gallons. At the end of each winter period, the DNAPL removal data is reviewed on an annual basis that combines summer and winter periods. When plotted, the annual data shows essentially the same response as the winter periods with periods of pooling and depletion with some duration variability (Figures C-3c and C-3d).

To further assess DNAPL recovery trends, the volume recovered from each trench segment (1 through 6) during the winter periods (May 2009 to May 2019) was plotted. The findings are provided on Table C-2, with slope intended to be characteristic of pooling (positive) or depletion (negative) and the correlation coefficient providing a measure of data variability. Positive slopes are noted at Segments 1, 3 and 4 with recharge ranging from 0.2 to 0.5 gallons/year. Given these low values, this data is interpreted to be reflective of an asymptotic response to slightly recharging. Negative slopes or depletion are seen in Segments 2, 5, and 6 ranging from -1.9 to -13.6 gallons/year. The lower values may be interpreted as an asymptotic response to slightly depleting (e.g., Segments 5 and 6), but the value from Segment 2 is reflective of depletion as demonstrated by the historical data (Figures 1 and 2). These results are similar

to the last four winter reporting periods (starting in winter period 2015) where negative slopes, or depletion, characterize Segments 2, 5, and 6, and shallow positive slopes (asymptotic response to slightly recharging) characterize Segments 1, 3 and 4. Since December 2008 through May 2009 when the winter period slope evaluation was started, the cumulative negative slopes are greater (averaging -5.9 gallons/year depletion) than the cumulative positive slopes (averaging 0.4 gallons/year asymptotic response to slightly recharging), which suggests the overall net effect is a depleting trend. With respect to future projections, since the overall DNAPL removal response appears to still follow the decay equation, the DNAPL volume removed is expected to be similar (but less) to this reporting period.

To further evaluate the DNAPL volume removed, it is plotted by well on Figure C-4 with the wells grouped into the segments. The variability of wells within each segment can be seen in this figure with the higher performing segments having consistently higher recovery from most well locations.

Over time, the DNAPL recovery data (i.e., gallons removed) has shown three distinguishable trends that include peak recovery, appreciable recovery decrease, followed by a flattening of recovery data akin to an asymptotic response. The DNAPL recovery response was illustrated graphically and numerically via averages and relationships between removal events and volume removed. In general, the averages and metrics have decreased as the volume removed decreases, but can be influenced by seasonal variations, volume removed from DRW-06, and periods of pooling and depletion. Seasonal variations were noted with summer period recovery greater than winter period recovery, which is attributed to changes in DNAPL viscosity due to seasonal temperature changes. This data is represented in Tables C-3, C-4a and C-4b and Figures C-5 and C-6.

#### **LIST OF TABLES**

- C-1 Average Monthly DNAPL Removed Compared to Total Removal Events – June 2002 Through May 2019
- C-2 Evaluation and Interpretation of Removal Trends for Trench DNAPL Recovery Wells – Winter Periods December 2008 through May 2019
- C-3 Summary of Apparent DNAPL Thickness in Wells and Averages
- C-4a DNAPL Volume Removed – 6-Month Comparison
- C-4b Apparent DNAPL Thickness Periodic Comparison

#### **LIST OF FIGURES**

- C-1 Average Monthly Volume Removed and Total Removal Events During 6-Month Reporting Periods
- C-2 Plot of Average DNAPL Manually Removed Per Removal Event Versus Time
- C-3a Semi-Logarithmic Plot of Volume Removed Versus Time for the “Winter Months”
- C-3b Linear Plot of Volume Removed Versus Time for the “Winter Months”
- C-3c Semi-Logarithmic Plot of Volume Removed Versus Time for the 12-Month Periods
- C-3d Linear Plot of Volume Removed Versus Time for the 12-Month Periods
- C-4 Summary of DNAPL Volume Removed by Well – December 2018 through May 2019
- C-5 Plot of Apparent Average Monthly DNAPL Thickness Versus Time for DRW-12 (Segment 5) and DRW-42 (Segment 3)
- C-6 Plot of Apparent Average Monthly DNAPL Thickness Versus Time for DRW-21 (Segment 6), DRW-25 (Segment 4) & DRW-32 (Segment 2)

TABLE C-1

**AVERAGE MONTHLY DNAPL REMOVED COMPARED TO TOTAL REMOVAL EVENTS  
JUNE 2002 THROUGH MAY 2019**

**DESC Calhoun Park Area Site  
Charleston, South Carolina**

Time Period	Duration (months)	Total Gallons Recovered <sup>(1)</sup>	Reporting Period Average Per Month (gallons)	Total Removal Events per period	Metric <sup>(2)</sup>
June 1, 2002 - November 30, 2002	6	2,683	447.2	445	1.01
December 1, 2002 - May 31, 2003	6	1,885	314.1	281	1.12
June 1, 2003 - November 30, 2003	6	2,415	402.4	334	1.20
December 1, 2003 - May 31, 2004	6	1,929	321.5	369	0.87
June 1, 2004 - November 30, 2004	6	2,018	336.3	424	0.79
December 1, 2004 - May 31, 2005	6	1,334	222.4	332	0.67
June 1, 2005 - November 30, 2005	6	1,725	287.6	447	0.64
December 1, 2005 - May 31, 2006	6	1,345	224.1	571	0.39
June 1, 2006 - November 30, 2006	6	1,309	218.1	460	0.47
December 1, 2006 - May 31, 2007	6	966	161.0	534	0.30
June 1, 2007 - November 30, 2007	6	1,025	170.8	483	0.35
December 1, 2007 - May 31, 2008	6	653	108.8	474	0.23
June 1, 2008 - November 30, 2008	6	644	107.4	430	0.25
December 1, 2008 - May 31, 2009	6	465	77.6	486	0.16
June 1, 2009 - November 30, 2009	6	600	100.1	424	0.24
December 1, 2009 - May 31, 2010	6	418	69.7	395	0.18
June 1, 2010 - November 30, 2010	6	540	90.0	320	0.28
December 1, 2010 - May 31, 2011	6	396	66.0	317	0.21
June 1, 2011 - November 30, 2011	6	486	80.9	302	0.27
December 1, 2011 - May 31, 2012	6	403	67.2	317	0.21
June 1, 2012 - November 30, 2012	6	512	85.4	280	0.30
December 1, 2012 - May 31, 2013	6	413	68.9	275	0.25
June 1, 2013 - November 30, 2013	6	613	102.1	271	0.38
December 1, 2013 - May 31, 2014	6	1,020	170.0	280	0.61
June 1, 2014 - November 30, 2014	6	1,200	200.0	262	0.76
December 1, 2014 - May 31, 2015	6	1,252	208.7	262	0.80
June 1, 2015 - November 30, 2015	6	1,242	207.0	258	0.80
December 1, 2015 - May 31, 2016	6	1,135	189.1	231	0.82
June 1, 2016 - November 30, 2016	6	1,209	201.5	251	0.80
December 1, 2016 - May 31, 2017	6	1,204	200.6	222	0.90
June 1, 2017 - November 30, 2017	6	1,238	206.4	241	0.86
December 1, 2017 - May 31, 2018	6	1,068	178.1	222	0.80
June 1, 2018 - November 30, 2018	6	1,146	191.0	213	0.90
December 1, 2018 - May 31, 2019	6	1,121	186.8	233	0.80

**Notes:**

(1) Gallons recovered are based on volume measured in drums used to store DNAPL during removal operations and includes all wells.

(2) Developed to quantify DNAPL removal efficiency. Metric is the reporting period average monthly volume removed divided by the total number of removal events for the period.



TABLE C-2

**EVALUATION AND INTERPRETATION OF REMOVAL TRENDS FOR TRENCH DNAPL RECOVERY WELLS  
WINTER PERIODS DECEMBER 2008 THROUGH MAY 2019**

**DESC Calhoun Park Area Site  
Charleston, South Carolina**

<b>Segment</b>	<b>Slope (gallons/year)</b>	<b>Correlation Coefficient (R<sup>2</sup>)</b>	<b>Cumulative DNAPL Volume Removed<sup>(1)</sup> (gallons)</b>	<b>Interpretation</b>
Segment 1	0.4	0.16	489.7	Poor R <sup>2</sup> suggests data variability during the DNAPL recovery period evaluated. The DNAPL trend is slightly positive, slope shallow, and indicates DNAPL recovery is asymptotic (i.e., recovery and recharge are essentially equal).
Segment 2	-13.6	0.94	9,690.3	Good R <sup>2</sup> suggests DNAPL recovery data has followed a "predictable" trend. The trend is negative suggesting depletion is occurring at an approximate rate of 14 gallons per year.
Segment 3	0.5	0.23	1,715.5	Poor R <sup>2</sup> suggests some data variability during the DNAPL recovery period evaluated. The trend is slightly positive, slope shallow, and indicates DNAPL recovery is asymptotic (i.e., recovery and recharge are essentially equal).
Segment 4	0.2	0.04	2,287.1	Poor R <sup>2</sup> suggest data variability during the DNAPL recovery period evaluated. The trend is slightly positive, slope shallow, and indicates DNAPL recovery is asymptotic (i.e., recovery and recharge are essentially equal).
Segment 5	-2.3	0.64	3,421.3	Moderate R <sup>2</sup> suggests DNAPL recovery data has followed a "definable" trend. The trend is negative and suggests depletion is occurring at an approximate rate of 2 gallons per year over the period evaluated.
Segment 6	-1.9	0.51	4,980.0	Moderate R <sup>2</sup> suggests some DNAPL recovery data variability over period evaluated. The trend is negative and suggests depletion is occurring at an approximate rate of 2 gallons per year over the period evaluated.

**Notes:**

- (1) Represents total cumulative DNAPL volume removed from March 2002 through May 2019 as shown on Figure 1.  
 (2) Winter periods starting with the December 2008 - May 2009 and through the December 2018 - May 2019 reporting periods.

**TABLE C-3**  
**SUMMARY OF APPARENT DNAPL THICKNESS IN WELLS AND AVERAGES**

DESC Calhoun Park Area Site  
Charleston, South Carolina

Well <sup>(1)</sup>	Apparent DNAPL Thickness (feet) at the Beginning of the Month <sup>(2,3)</sup>			Change in Apparent DNAPL Thickness from March 2002 to April 2019 (feet)	Percent Change from March 2002 to April 2019
	March 2002	January 4 - 29, 2019	April 4 - 23, 2019		
DNAPL Recovery Wells					
DRW-02	3.65	0.15	0.01	-3.50	-95.9%
DRW-06	2.29	10.95	10.75	8.46	369%
DRW-07 <sup>(4)</sup>	0.42	0.01	0.01	-0.41	-98%
DRW-08 <sup>(4)</sup>	0.50	0.39	0.01	-0.49	-98%
DRW-09 <sup>(4,5)</sup>	0.00	0.01	0.01	0.01	undefined
DRW-10 <sup>(6)</sup>	0.00	0.00	0.00	0.00	no change
DRW-11 <sup>(6)</sup>	0.00	0.00	0.00	0.00	no change
DRW-12	1.42	0.50	0.38	-1.04	-73%
DRW-13	1.00	0.92	0.38	-0.62	-62%
DRW-14	1.33	0.28	0.29	-1.04	-78%
DRW-15	1.67	0.33	0.28	-1.39	-83%
DRW-16	0.96	0.26	0.17	-0.79	-82%
DRW-17	0.88	0.28	0.28	-0.60	-68%
DRW-18	0.21	0.23	0.25	0.04	19%
DRW-19	0.17	0.64	0.28	0.11	65%
DRW-20	3.83	0.18	0.13	-3.70	-97%
DRW-21	2.92	0.62	0.89	-2.03	-70%
DRW-22	0.46	0.47	0.27	-0.19	-41%
DRW-23	0.54	0.20	0.01	-0.53	-98%
DRW-24	1.42	0.19	0.22	-1.20	-85%
DRW-25 <sup>(4)</sup>	3.08	0.13	0.19	-2.89	-94%
DRW-26	2.13	0.23	0.17	-1.96	-92%
DRW-27 <sup>(4)</sup>	0.17	0.01	0.01	-0.16	-94%
DRW-28	1.25	0.18	0.21	-1.04	-83%
DRW-29 <sup>(4)</sup>	0.30	0.00	0.01	-0.29	-97%
DRW-30	1.83	0.19	0.19	-1.64	-90%
DRW-31 <sup>(4)</sup>	1.50	0.01	0.08	-1.42	-95%
DRW-32	4.67	0.77	0.38	-4.31	-92%
DRW-33	2.25	0.41	0.51	-1.74	-77%
DRW-34	3.83	0.42	0.73	-3.10	-81%
DRW-35	1.75	0.46	0.86	-0.89	-51%
DRW-36	1.58	0.14	0.14	-1.44	-91%
DRW-37	1.42	0.37	0.18	-1.24	-87%
DRW-38	1.75	0.18	0.27	-1.48	-85%
DRW-39	1.25	0.20	0.19	-1.06	-85%
DRW-40	0.67	0.21	0.19	-0.48	-72%
DRW-41	2.50	0.70	0.39	-2.11	-84%
DRW-42	1.17	0.36	0.43	-0.74	-63%
DRW-45	2.08	0.14	0.12	-1.96	-94%
DRW-46	0.92	0.11	0.10	-0.82	-89%
DRW-47 <sup>(5)</sup>	0.00	0.25	0.20	0.20	undefined
DRW-48	0.83	0.43	0.38	-0.45	-54%
DRW-49 <sup>(4)</sup>	0.01	0.00	0.00	-0.01	-100%
DRW-50 <sup>(4)</sup>	0.54	0.01	0.11	-0.43	-80%
DRW-51	0.33	0.28	0.40	0.07	21%
Average Thickness (feet)	1.37	0.51	0.48		
Average Change in Apparent DNAPL Thickness (feet):				-0.90	
Shallow Monitoring Wells					
Well	Apparent DNAPL Thickness (feet) and Month Measured <sup>(2,3)</sup>			Change in Apparent DNAPL Thickness from March 2002 to April 2019 (feet)	Percent Change from March 2002 to April 2019
	March 2002	January 4 - 29, 2019	April 4 - 23, 2019		
A3-T3 <sup>(2,4,5)</sup>	0.00	0.15	0.25	0.15	undefined
CM-03A	0.40	0.99	0.63	0.23	58%
MM-11A	1.33	1.30	0.82	-0.51	-38%
MW-12A <sup>(2)</sup>	0.01	0.85	0.60	0.59	5900%
MZ-06M <sup>(4)</sup>	0.85	0.01	0.01	-0.84	-99%
MZ-55A	0.35	0.89	1.05	0.70	200%
ORC-7 <sup>(2,4,5)</sup>	0.00	0.01	0.01	0.01	undefined
Average Thickness (feet)	0.42	0.60	0.48		
Average Change in Apparent DNAPL Thickness (feet):				0.05	
Intermediate Monitoring Wells					
Well	Apparent DNAPL Thickness (feet) and Month Measured <sup>(2,3)</sup>			Change in Apparent DNAPL Thickness from March 2002 to April 2019 (feet)	Percent Change from March 2002 to April 2019
	March 2002	January 4 - 29, 2019	April 4 - 23, 2019		
DRW-52C <sup>(4)</sup>	0.01	0.30	0.30	0.29	2900%
DRW-53C <sup>(4)</sup>	0.85	0.01	0.01	-0.84	-99%
MM-01B <sup>(4)</sup>	3.15	0.29	0.01	-3.14	-99.7%
MM-02B	7.00	2.87	2.20	-4.80	-69%
MM-15C <sup>(4)</sup>	0.90	0.01	0.01	-0.89	-99%
Average Thickness (feet)	2.38	0.70	0.51		
Average Change in Apparent DNAPL Thickness (feet):				-1.88	

**Notes:**

- (1) Represents wells where DNAPL was removed at least once during the reporting period or select others with DNAPL thickness measurements during the period.
- (2) March 2002 data used as a reference point, except for A3-T3, DRW-52C, DRW-53C and ORC-7. DRW-52C and DRW-53C were installed in December 2003 and DNAPL thickness on January 8, 2004 (DRW-52C) and January 28, 2004 (DRW-53C) are used as reference. Wells A3-T3 and ORC-7 added to quarterly measurements in January 2014 and DNAPL thickness reference date is September 2002 since these wells were not measured in March 2002. For MW-12A, the initial measurement is from September 2002 since ORC socks were located in this well in March 2002 and a measurement was not made.
- (3) Data provided from the weekly, monthly, quarterly and annual apparent DNAPL thickness monitoring events. The dates listed represents the timeframe that apparent DNAPL thickness measurements were made since typically measurements may be made over a multiple day period.
- (4) A value of 0.01 feet generally indicates trace DNAPL was measured. A value of 0.00 feet generally indicates no product was measured.
- (5) March 2002 or September 2002 apparent DNAPL thickness was 0.00 feet and therefore quotient is undefined.
- (6) DRW-10 and DRW-11 are measured annually in April. The January data is from April 2018.

**TABLE C-4a**  
**DNAPL VOLUME REMOVED - 6-MONTH COMPARISON**

DESC Calhoun Park Area Site  
Charleston, South Carolina

RECOVERY WELLS	COMPARISON OF DNAPL VOLUME REMOVED (GALLONS)																							
	Mar-02 - Aug-02		Sep-02 - Nov-02		Dec-02 - May-03		Jun-03 - Nov-03		Dec-03 - May-04		Jun-04 - Nov-04		Dec-04 - May-05		Jun-05 - Nov-05		Dec-05 - May-06		Jun-06 - Nov-06		Dec-06 - May-07		Jun-07 - Nov-07	
	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month
Well DRW-06	489	82	397	132	620	103	667	111	649	108	465	77	207	35	212	35	260	43	151	25	199	33	202	34
Recovery Trench Wells DRW-08 through DRW-51	1,845	308	922	307	1,258	210	1,739	290	1,262	210	1,544	257	1,115	186	1,485	247	1,067	178	1,145	191	749	125	806	134
Shallow Monitoring Wells CM-03A, MM-11A, MW-12A, MZ-06M and MZ-55A	1.91	0.32	0.21	0.07	0.85	0.14	0.70	0.12	0.68	0.11	0.21	0.04	0.31	0.05	1.47	0.25	0.86	0.14	0.24	0.04	0.70	0.12	0.17	0.03
Intermediate Wells DRW-52C, DRW-53C, MM-01B, MM-02B and MM-15C	20.18	3.36	6.79	2.26	5.47	0.91	8.06	1.34	17.59	2.93	9.22	1.54	11.33	1.89	15.10	2.52	14.62	2.44	11.97	2.00	17.00	2.83	15.64	2.61
<b>Total</b>	<b>2,356</b>	<b>393</b>	<b>1,326</b>	<b>442</b>	<b>1,885</b>	<b>314</b>	<b>2,415</b>	<b>402</b>	<b>1,929</b>	<b>322</b>	<b>2,018</b>	<b>336</b>	<b>1,334</b>	<b>222</b>	<b>1,713</b>	<b>286</b>	<b>1,342</b>	<b>224</b>	<b>1,309</b>	<b>218</b>	<b>965</b>	<b>161</b>	<b>1,024</b>	<b>171</b>

RECOVERY WELLS	COMPARISON OF DNAPL VOLUME REMOVED (GALLONS)																							
	Dec-07 - May-08		Jun-08 - Nov-08		Dec-08 - May-09		Jun-09 - Nov-09		Dec-09 - May-10		Jun-10 - Nov-10		Dec-10 - May-11		Jun-11 - Nov-11		Dec-11 - May-12		Jun-12 - Nov-12		Dec-12 - May-13		Jun-13 - Nov-13	
	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month
Well DRW-06	88	15	68	11	75	13	90	15	65	11	88	15	66	11	62	10	73	12	87	15	109	18	271	45
Recovery Trench Wells DRW-08 through DRW-51	551	92	560	93	375	62	497	83	341	57	444	74	321	53	413	69	319	53	412	69	296	49	333	55
Shallow Monitoring Wells CM-03A, MM-11A, MW-12A, MZ-06M and MZ-55A	0.17	0.03	1.04	0.17	1.32	0.22	0.22	0.04	0.85	0.14	0.88	0.15	1.05	0.18	1.16	0.19	1.41	0.24	1.03	0.17	0.43	0.07	1.43	0.24
Intermediate Wells DRW-52C, DRW-53C, MM-01B, MM-02B and MM-15C	13.48	2.25	15.47	2.58	14.16	2.36	10.25	1.71	11.32	1.89	7.50	1.25	7.94	1.32	9.73	1.62	9.26	1.54	9.00	1.50	8.07	1.35	7.78	1.30
<b>Total</b>	<b>653</b>	<b>109</b>	<b>644</b>	<b>107</b>	<b>465</b>	<b>78</b>	<b>597</b>	<b>99</b>	<b>418</b>	<b>70</b>	<b>540</b>	<b>90</b>	<b>396</b>	<b>66</b>	<b>486</b>	<b>81</b>	<b>403</b>	<b>67</b>	<b>510</b>	<b>85</b>	<b>413</b>	<b>69</b>	<b>613</b>	<b>102</b>

RECOVERY WELLS	COMPARISON OF DNAPL VOLUME REMOVED (GALLONS)																							
	Dec-13 - May-14		Jun-14 - Nov-14		Dec-14 - May-15		Jun-15 - Nov-15		Dec-15 - May-16		Jun-16 - Nov-16		Dec-16 - May-17		Jun-17 - Nov-17		Dec-17 - May-18		Jun-18 - Nov-18		Dec-18 - May-19			
	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month	Total	Avg./Month
Well DRW-06	743	124	890	148	1,010	168	947	158	894	149	895	149	957	160	955	159	845	141	892	148.67	903	150		
Recovery Trench Wells DRW-08 through DRW-51	268	44	300	50	232	39	286	48	232	39	306	51	238	40	270	45	213	35	245	40.83	206	34		
Shallow Monitoring Wells A3-T3, CM-03A, MM-11A, MW-12A, MZ-06M, MZ-55A and ORC-7 <sup>(1)</sup>	2.32	0.39	0.72	0.12	1.03	0.17	0.44	0.07	1.02	0.17	0.5	0.08	0.65	0.11	0.55	0.09	1.50	0.25	0.35	0.06	1.85	0.31		
Intermediate Wells DRW-52C, DRW-53C, MM-01B, MM-02B and MM-15C	8.33	1.39	7.75	1.29	9.03	1.51	8.27	1.38	7.59	1.27	8.32	1.39	7.65	1.28	12.25	2.04	9.50	1.58	8.35	1.39	10.5	1.75		
<b>Total</b>	<b>1,020</b>	<b>170</b>	<b>1,199</b>	<b>200</b>	<b>1,252</b>	<b>209</b>	<b>1,242</b>	<b>207</b>	<b>1,135</b>	<b>189</b>	<b>1,210</b>	<b>202</b>	<b>1,204</b>	<b>201</b>	<b>1,237</b>	<b>206</b>	<b>1,068</b>	<b>178</b>	<b>1,146</b>	<b>191</b>	<b>1,121</b>	<b>187</b>		

**Notes:**

(1) Shallow monitoring well A3-T3 was added during the June 2014 through November 2014 event due to the well being pumped for the first time. Pumping has not been performed on ORC-7 due to the limited DNAPL volume in this well.

TABLE C-4b

## APPARENT DNAPL THICKNESS PERIODIC COMPARISON

DESC Calhoun Park Area Site  
Charleston, South Carolina

RECOVERY WELLS	COMPARISON OF APPARENT DNAPL THICKNESS (FEET)											
	Mar-02 - Aug-02	Sep-02 - Nov-02	Dec-02 - May-03	Jun-03 - Nov-03	Dec-03 - May-04	Jun-04 - Nov-04	Dec-04 - May-05	Jun-05 - Nov-05	Dec-05 - May-06	Jun-06 - Nov-06	Dec-06 - May-07	Jun-07 - Nov-07
Well DRW-06	4.71	4.55	3.25	6.60	6.82	6.58	5.51	5.77	3.25	5.95	4.00	2.18
Recovery Trench Wells DRW-08 through DRW-51	0.75	0.79	0.83	1.08	0.91	0.96	0.90	0.98	0.51	0.70	0.55	0.46
Shallow Monitoring Wells CM-03A, MM-11A, MW-12A, MZ-06M and MZ-55A	0.21	0.76	0.74	0.80	1.22	0.50	0.54	0.74	0.59	0.46	0.61	0.65
Intermediate Wells DRW-53C, MM-01B, MM-02B and MM-15C	1.45	1.43	1.33	2.81	3.26	1.84	1.41	1.91	1.75	1.31	2.72	2.59

RECOVERY WELLS	COMPARISON OF APPARENT DNAPL THICKNESS (FEET)											
	Dec-07 - May-08	Jun-08 - Nov-08	Dec-08 - May-09	Jun-09 - Nov-09	Dec-09 - May-10	Jun-10 - Nov-10	Dec-10 - May-11	Jun-11 - Nov-11	Dec-11 - May-12	Jun-12 - Nov-12	Dec-12 - May-13	Jun-13 - Nov-13
Well DRW-06	2.93	0.70	4.57	1.73	4.38	3.75	3.50	2.23	3.73	4.65	4.10	7.30
Recovery Trench Wells DRW-08 through DRW-51	0.39	0.46	0.44	0.42	0.40	0.46	0.48	0.52	0.37	0.41	0.40	0.34
Shallow Monitoring Wells CM-03A, MM-11A, MW-12A, MZ-06M and MZ-55A	0.42	0.36	0.58	0.37	0.36	0.22	0.26	0.53	0.26	0.82	0.33	1.27
Intermediate Wells DRW-53C, MM-01B, MM-02B and MM-15C	1.42	1.33	2.40	1.18	1.26	1.14	1.12	1.55	0.95	0.88	0.83	0.87

RECOVERY WELLS	COMPARISON OF APPARENT DNAPL THICKNESS (FEET)											
	Dec-13 - May-14	Jun-14 - Nov-14	Dec-14 - May-15	Jun-15 - Nov-15	Dec-15 - May-16	Jun-16 - Nov-16	Dec-16 - May-17	Jun-17 - Nov-17	Dec-17 - May-18	Jun-18 - Nov-18	Dec-18 - May-19 <sup>(1)</sup>	
Well DRW-06	9.20	9.98	10.89	10.41	10.86	10.82	10.99	10.73	11.10	10.89	10.85	
Recovery Trench Wells DRW-08 through DRW-51	0.35	0.37	0.29	0.34	0.26	0.32	0.29	0.34	0.28	0.30	0.26	
Shallow Monitoring Wells A3-T3, CM-03A, MM-11A, MW-12A, MZ-06M, MZ-55A, and ORC-7 <sup>(2)</sup>	0.66	0.43	0.36	0.52	0.64	0.51	0.62	0.65	0.63	0.51	0.54	
Intermediate Wells DRW-52C, DRW-53C, MM-01B, MM-02B and MM-15C	0.88	0.85	0.81	0.74	1.08	0.67	0.59	0.69	0.67	0.56	0.56	

## Note:

(1) Represents average of apparent thickness measurements made in December 2018 through May 2019.

(2) A3-T3 and ORC-7 added during the December 2013 - May 2014 event.

FIGURE C-1

AVERAGE MONTHLY VOLUME REMOVED AND  
TOTAL REMOVAL EVENTS DURING 6-MONTH REPORTING PERIODS

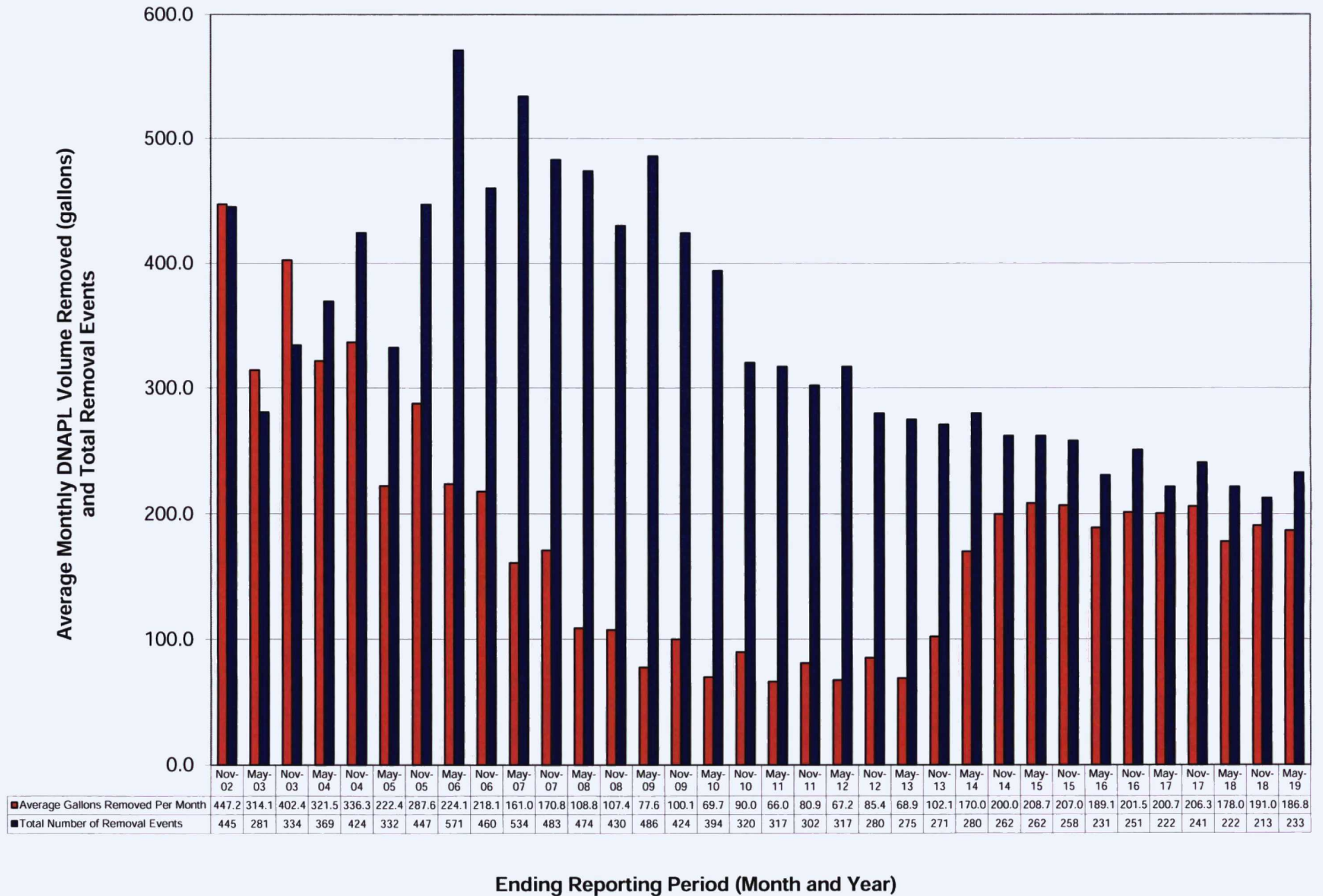
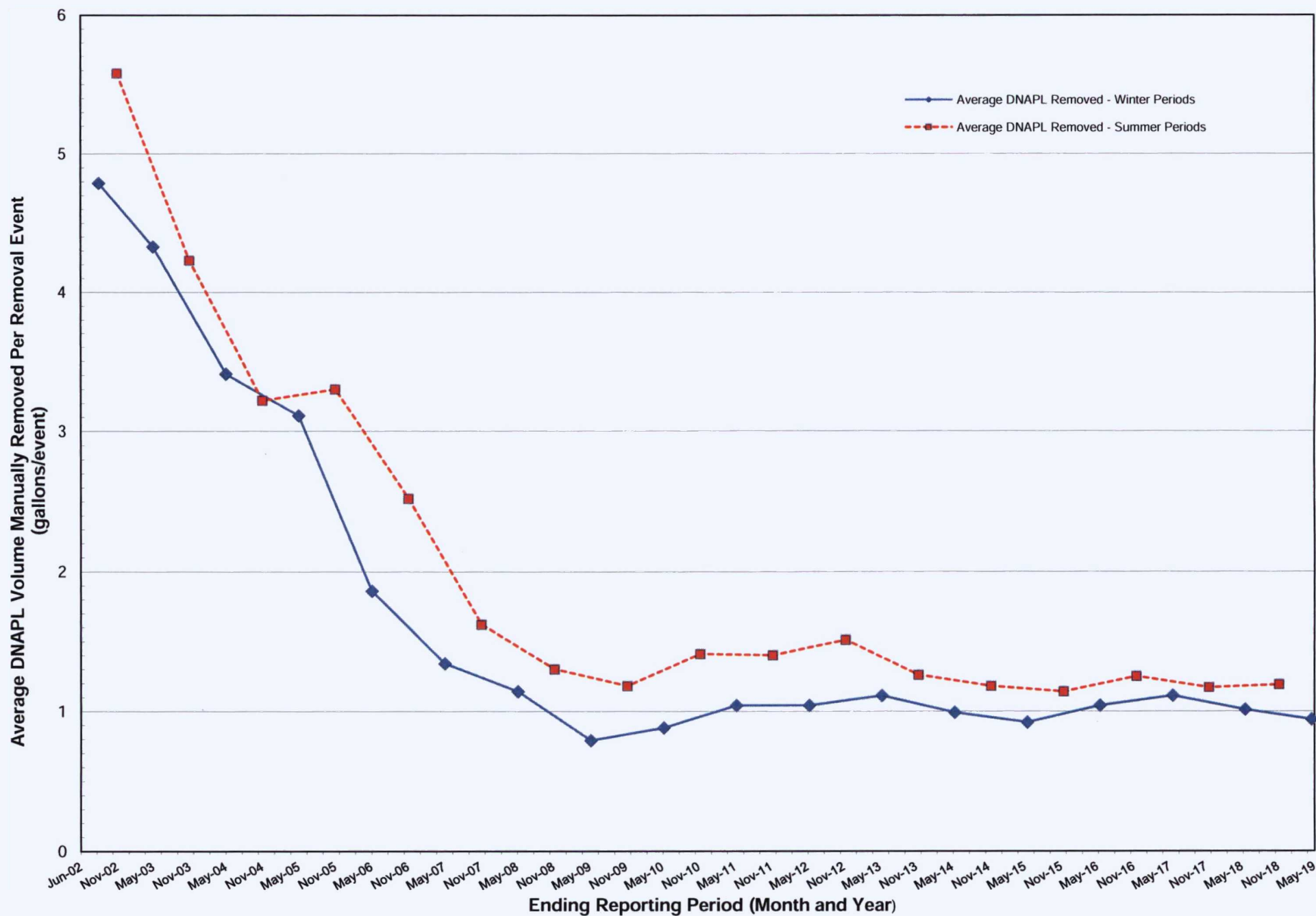
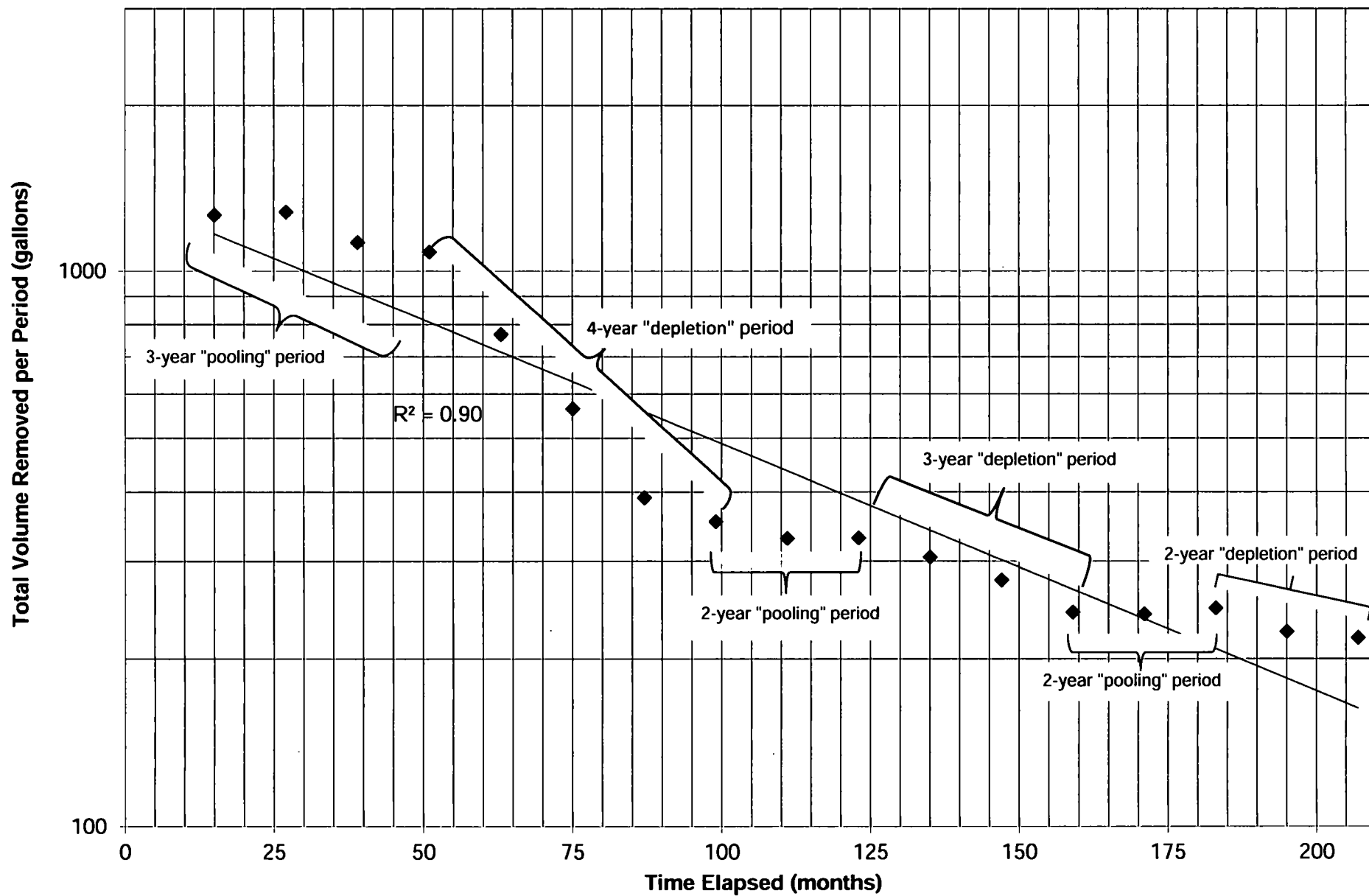


FIGURE C-2

PLOT OF AVERAGE DNAPL MANUALLY REMOVED PER REMOVAL EVENT VERSUS TIME



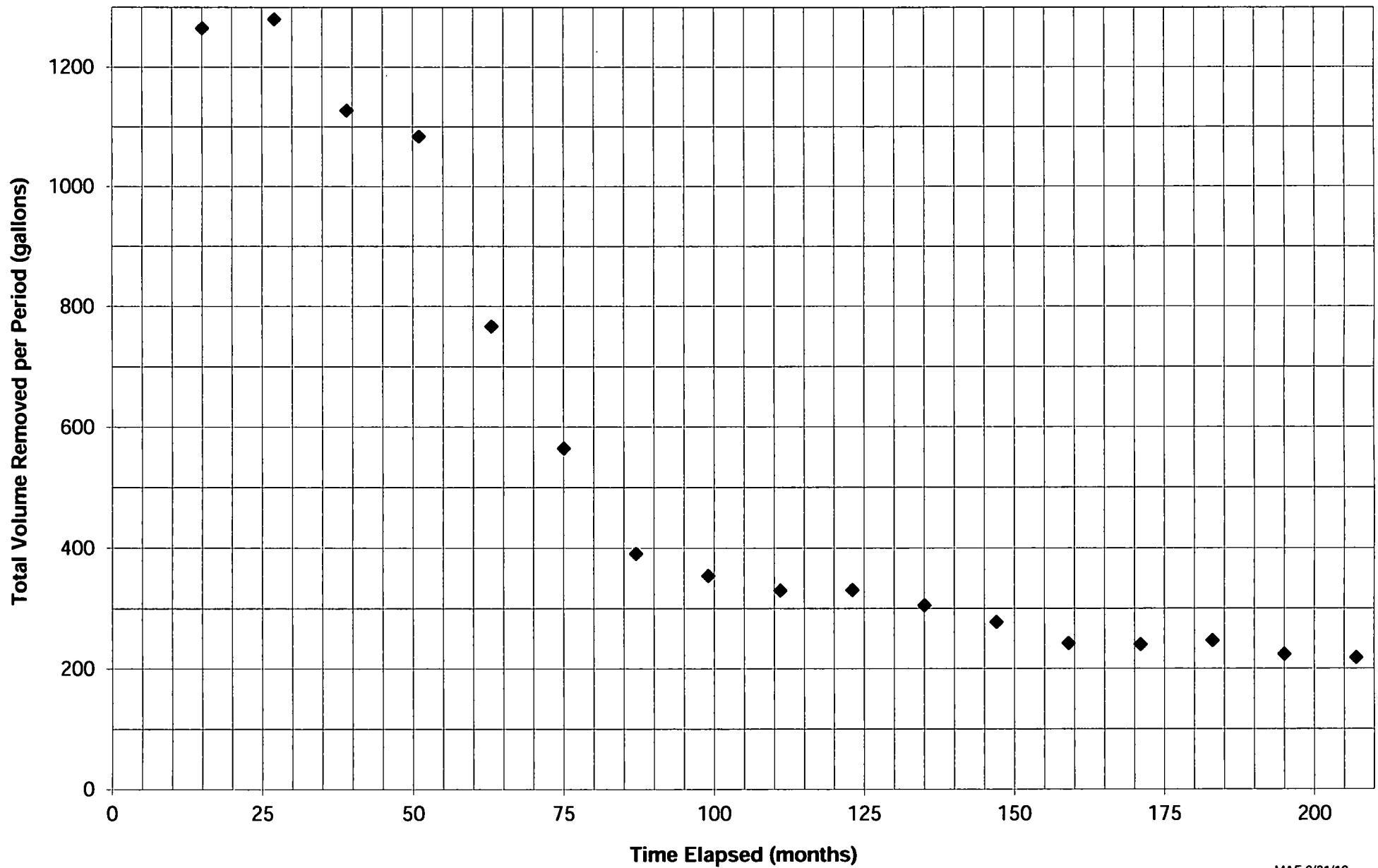
**FIGURE C-3a**  
**SEMI-LOGARITHMIC PLOT OF VOLUME REMOVED VERSUS TIME FOR THE "WINTER MONTHS"**  
 (December through May)



**Note:** Includes all wells where DNAPL was removed except gasholder wells (DRW-02 , DRW-06 , and DRW-07)



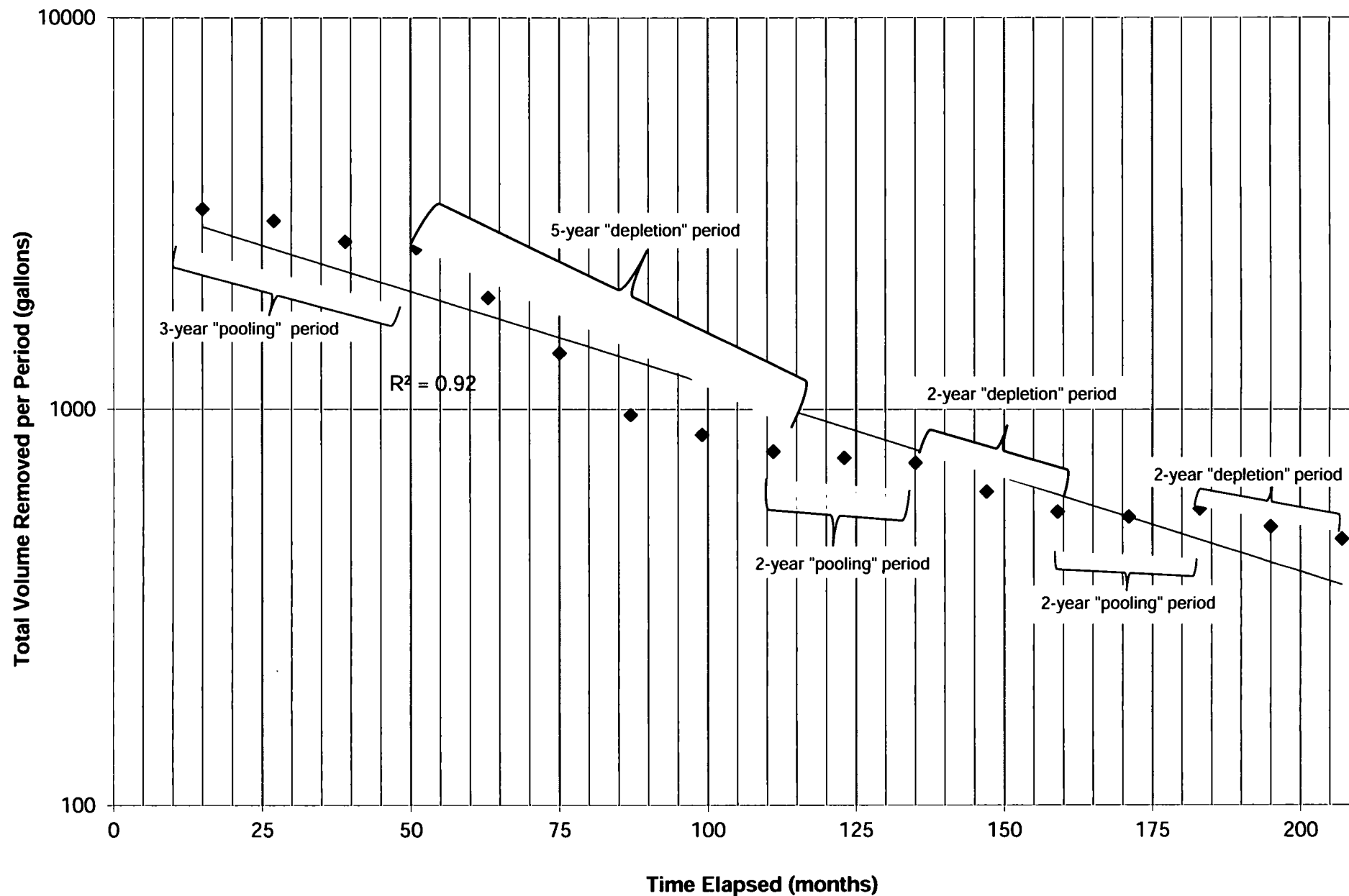
**FIGURE C-3b**  
**LINEAR PLOT OF VOLUME REMOVED VERSUS TIME FOR THE "WINTER MONTHS"**  
(December through May)



**Note:** Includes all wells where DNAPL was removed except gasholder wells (DRW-02, DRW-06, and DRW-07)

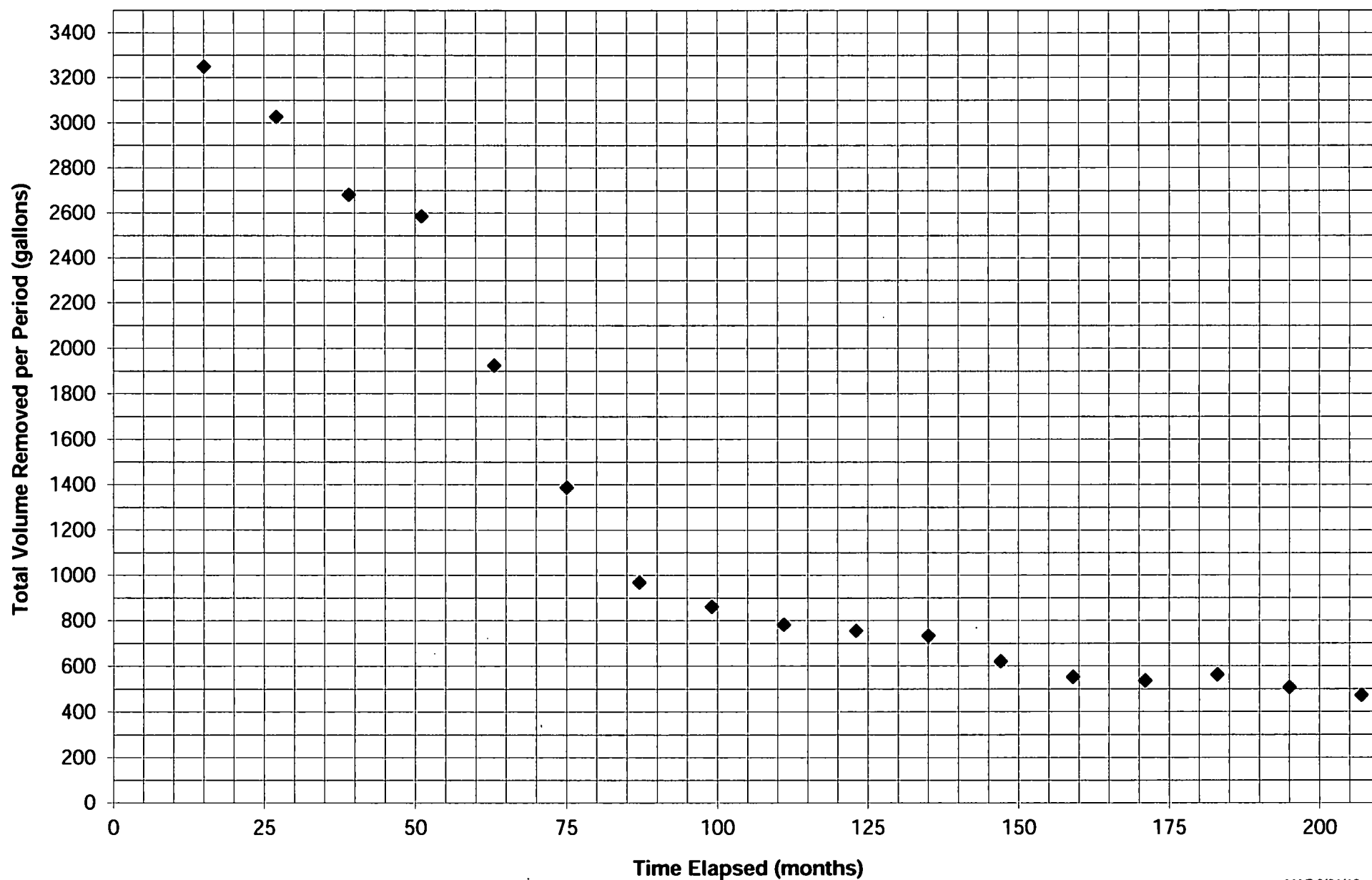
MAF 8/21/19

**FIGURE C-3c**  
**SEMI-LOGARITHMIC PLOT OF VOLUME REMOVED VERSUS TIME FOR THE 12-MONTH PERIODS**  
 (June through May)



**Note:** Includes all wells where DNAPL was removed except gasholder wells (DRW-02 , DRW-06, and DRW-07)

**FIGURE C-3d**  
**LINEAR PLOT OF VOLUME REMOVED VERSUS TIME FOR THE 12-MONTH PERIODS**  
**(June through May)**

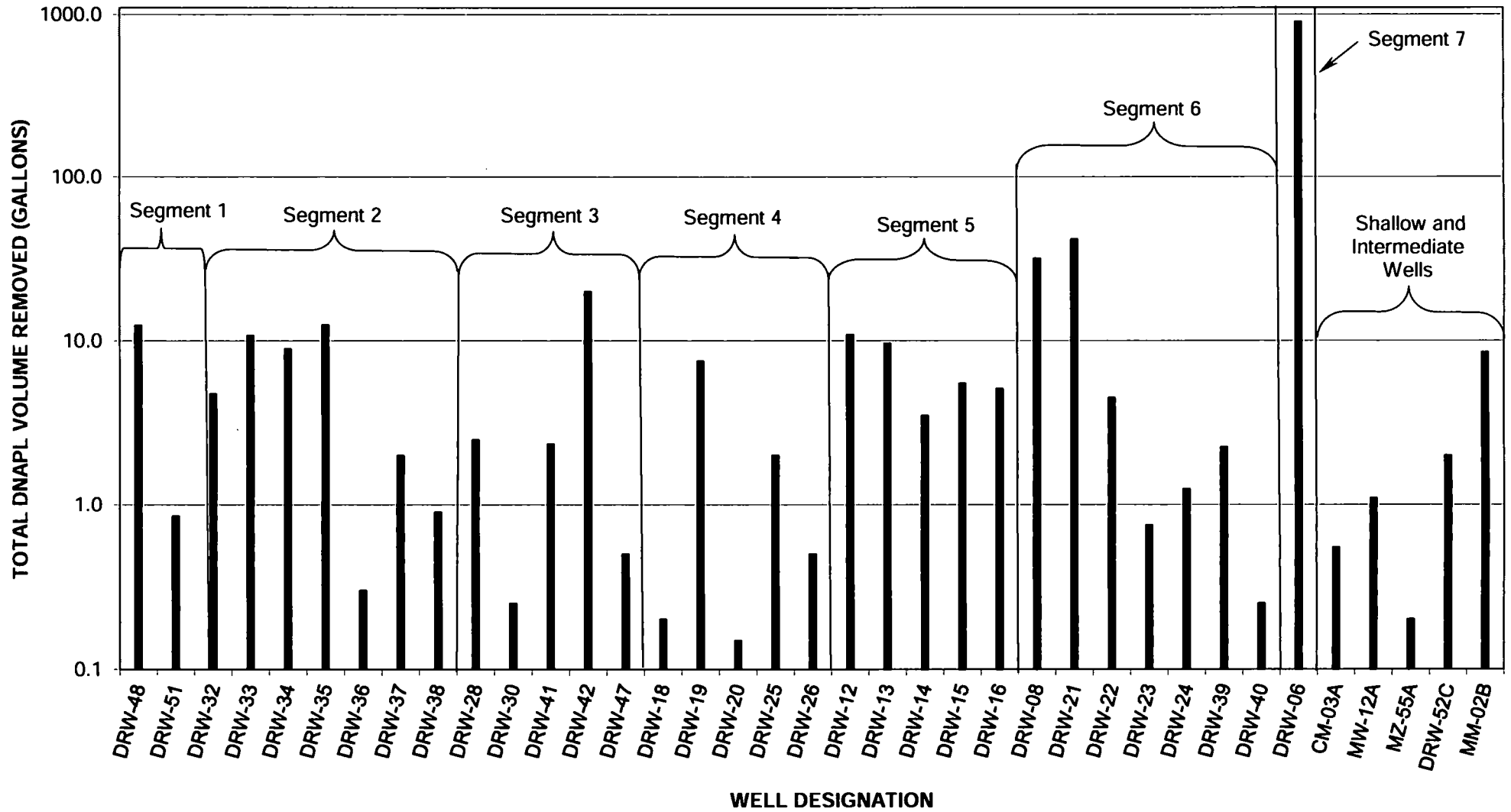


Note: Includes all wells where DNAPL was removed except gasholder wells (DRW-02, DRW-06, and DRW-07)

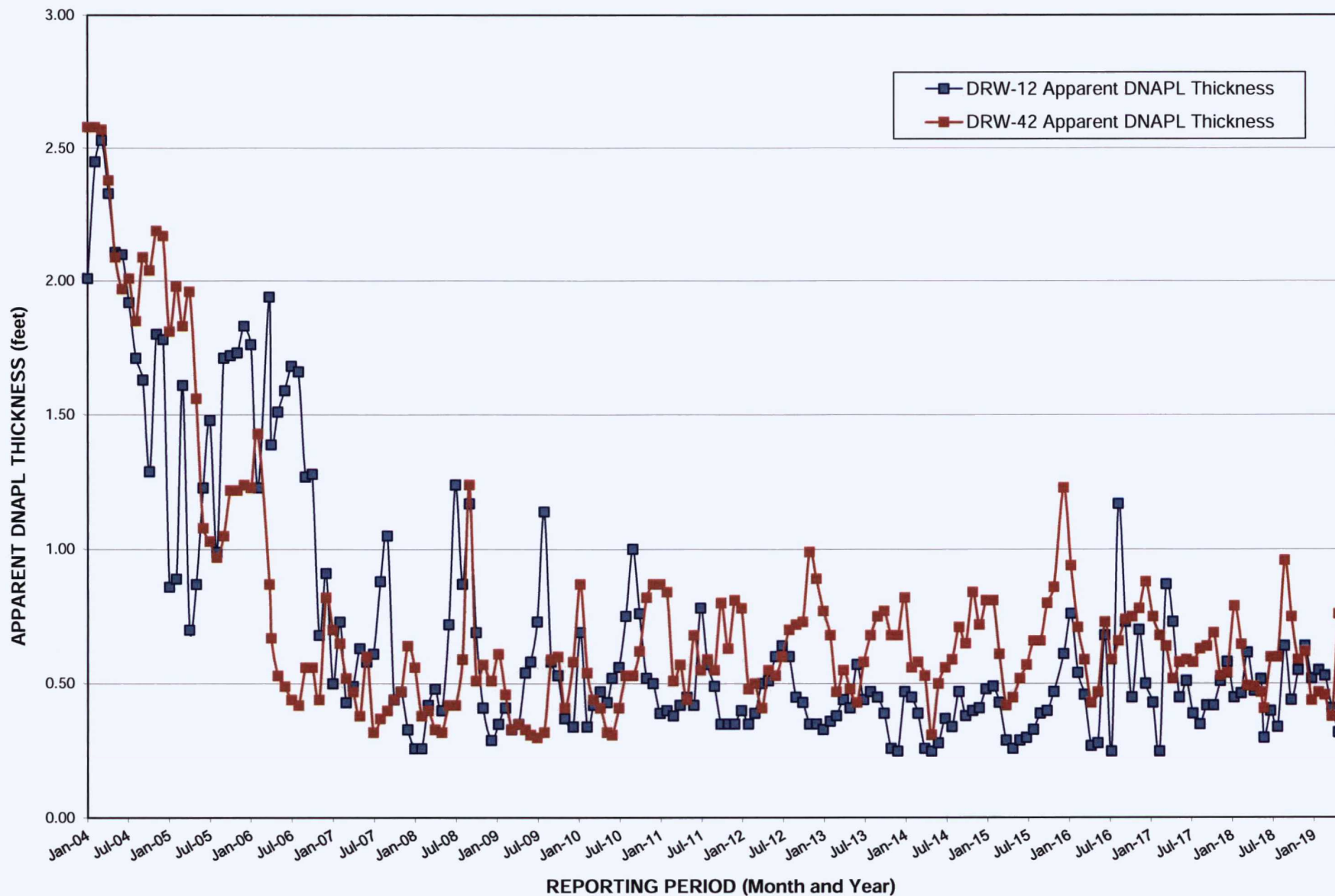
MAF 8/21/19

FIGURE C-4

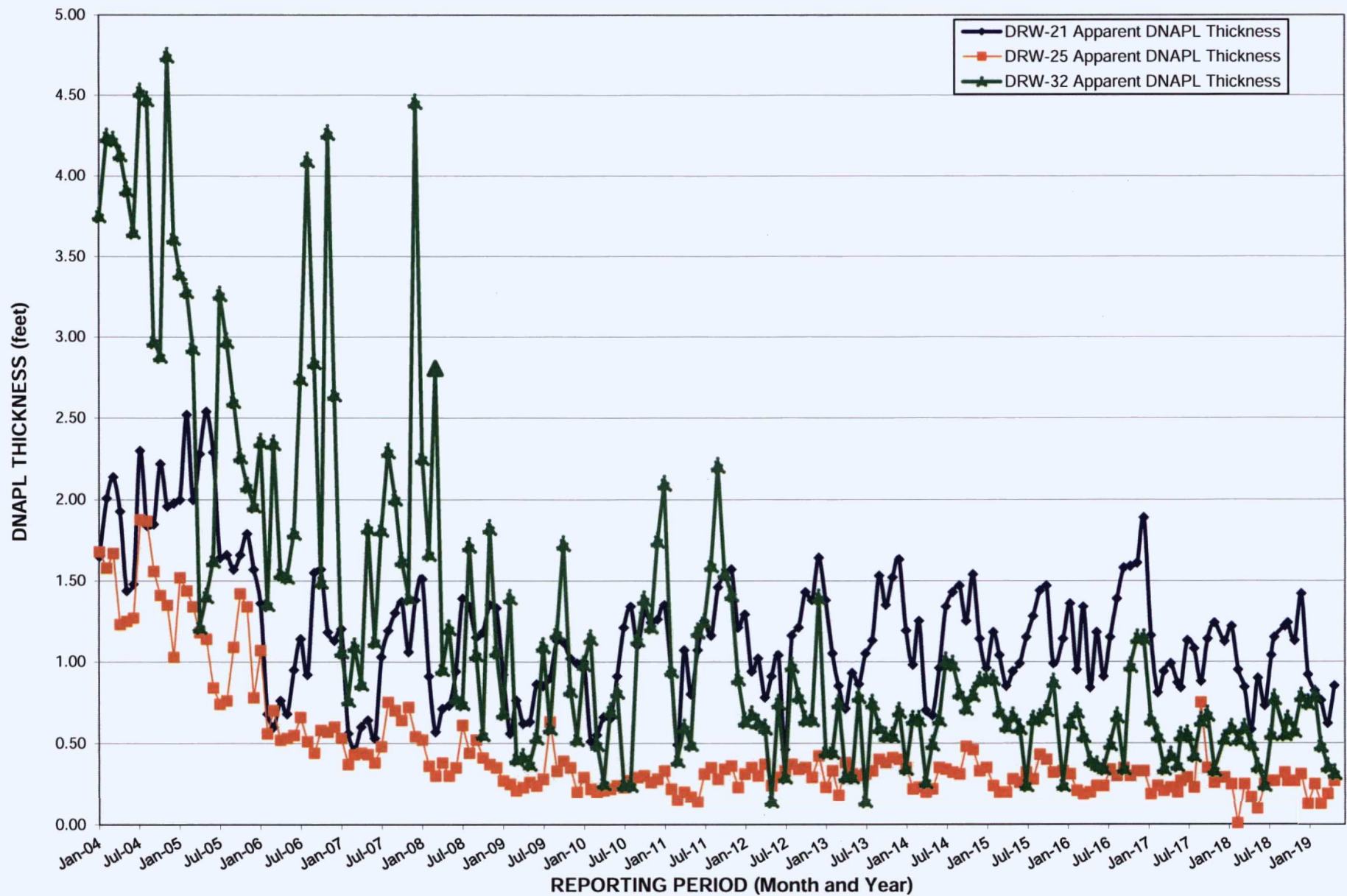
SUMMARY OF DNAPL VOLUME REMOVED BY WELL  
DECEMBER 2018 THROUGH MAY 2019



**FIGURE C-5**  
**PLOT OF APPARENT AVERAGE MONTHLY**  
**DNAPL THICKNESS VERSUS TIME FOR DRW-12 (SEGMENT 5) AND DRW-42 (SEGMENT 3)**



**FIGURE C-6**  
**PLOT OF APPARENT AVERAGE MONTHLY**  
**DNAPL THICKNESS VERSUS TIME FOR DRW-21 (Segment 6), DRW-25 (Segment 4) & DRW-32 (Segment 2)**



**ATTACHMENT D**

**MW-12A DNAPL MEASUREMENTS AND PUMPING ACTIVITY**



**TABLE D-1**  
**MW-12A DNAPL MEASUREMENTS AND PUMPING ACTIVITY**

DESC Calhoun Park Area Site  
Charleston, South Carolina

Date	Apparent DNAPL Thickness (feet)	DNAPL Removed (gallons) <sup>(2)</sup>	Date	Apparent DNAPL Thickness (feet)	DNAPL Removed (gallons) <sup>(2)</sup>	Date	Apparent DNAPL Thickness (feet)	DNAPL Removed (gallons) <sup>(2)</sup>
08/25/92	Well Installed	--	11/15/10	2.10	0.34	01/13/15	0.58	NR
09/04/92	0.21	0.03	12/15/10	0.84	NR	02/05/15	0.73	NR
09/28/92	NP <sup>(1)</sup>	NR <sup>(1)</sup>	01/07/11	2.15	NR	02/25/15	0.89	0.15
01/06/00	0.40	0.06	01/14/11	2.15	0.35	03/31/15	0.47	NR
01/07/00	Trace	NR	02/07/11	1.00	NR	04/08/15	0.50	0.08
01/31/00	Trace	NR	03/18/11	2.20	NR	05/13/15	0.42	NR
02/11/00	Trace	0.05	03/22/11	2.20	0.36	06/08/15	0.63	NR
07/06/00	Trace	NR	04/07/11	0.88	NR	07/01/15	0.65	0.11
07/26/00	Trace	NR	05/03/11	1.00	0.16	07/15/15	0.20	NR
12/12/00	0.06	NR	05/24/11	1.08	0.18	08/07/15	0.65	NR
03/21/01	Trace	NR	06/09/11	1.15	NR	09/18/15	1.02	NR
03/30/01	ORC Socks Installed	--	06/10/11	1.15	0.19	09/21/15	1.02	0.17
04/16/02	ORC Socks Removed	--	07/07/11	0.87	0.11	10/12/15	0.00	NR
09/09/02	Trace	NR	08/04/11	1.40	NR	11/19/15	0.81	NR
11/18/02	0.35	NR	08/05/11	1.40	0.23	12/18/15	0.94	0.15
01/07/03	0.25	NR	08/31/11	1.51	0.25	01/26/16	0.62	NR
03/04/03	0.25	NR	09/15/11	0.82	NR	02/25/16	0.60	0.10
04/08/03	0.17	NR	10/13/11	1.60	NR	03/29/16	0.45	NR
07/07/03	0.40	NR	11/03/11	2.36	0.38	04/25/16	0.70	NR
09/09/03	0.40	NR	12/08/11	1.25	NR	05/16/16	0.75	NR
10/08/03	0.57	NR	12/21/11	1.25	NR	06/02/16	0.68	NR
01/12/04	0.80	NR	01/05/12	1.24	NR	07/19/16	0.25	NR
03/02/04	0.25	NR	01/12/12	1.24	0.20	08/26/16	1.13	NR
04/06/04	0.16	NR	02/15/12	1.92	NR	08/31/16 <sup>(2)</sup>	1.20	0.25
07/07/04	0.50	NR	02/22/12	1.92	0.31	09/19/16	0.43	NR
10/06/04	Trace	NR	03/09/12	1.00	NR	10/13/16	0.45	NR
01/11/05	0.90	NR	04/03/12	1.40	0.23	11/21/16	0.70	NR
04/05/05	0.90	NR	05/10/12	2.25	NR	12/19/16	0.93	NR
07/08/05	Trace	NR	05/17/12	2.25	0.37	01/25/17	1.05	NR
08/25-30/05 <sup>(3)</sup>	0.13	NR	06/07/12	1.15	NR	02/20/17	1.15	NR
10/07/05	0.30	NR	07/12/12	1.85	NR	03/28/17	1.35	NR
01/12/06	0.20	NR	07/18/12	2.02	0.33	03/29/17	1.35	0.25
04/06/06	0.06	NR	08/08/12	1.10	0.18	04/19/17	0.28	NR
07/06/06	0.23	NR	09/19/12	1.30	NR	05/15/17	0.70	NR
10/02/06	0.15	NR	09/20/12	1.30	0.21	06/23/17	0.75	NR
01/10/07	0.46	NR	10/11/12	0.90	0.15	07/13/17	0.70	NR
03/05/07	0.40	NR	11/19/12	1.00	NR	08/22/17	0.75	NR
04/03/07	0.15	NR	11/20/12	1.00	0.16	08/30/17	0.85	0.15
12/08/07	1.88	NR	12/14/12	0.65	NR	09/18/17	0.25	NR
07/16/08	3.71	0.60	01/11/13	1.00	NR	10/11/17	0.50	0.10
08/29/08	1.15	0.19	01/31/13	1.03	0.17	10/25/17	0.44	NR
09/03/08	0.24	NR	02/21/13	0.53	NR	11/16/17	0.55	NR
12/05/08	2.35	0.38	02/21/13	0.55	0.09	12/12/17	0.55	NR
01/12/09	1.62	0.26	03/11/13	0.38	NR	01/24/18	0.84	NR
02/06/09	0.81	NR	04/05/13	0.66	NR	02/20/18	0.85	NR
03/26/09	1.43	0.23	04/25/13	0.72	0.12	02/21/18	0.85	0.15
04/06/09	0.15	NR	05/09/13	0.35	NR	03/14/18	0.38	NR
05/07/09	0.71	NR	06/04/13	0.88	NR	04/18/18	0.55	NR
05/15/09	0.8	0.13	06/06/13	0.88	0.14	05/14/18	0.60	NR
06/01/09	0.15	NR	07/10/13	0.60	NR	06/08/18	0.70	0.15
07/01/09	0.72	0.12	08/08/13	1.95	0.32	06/20/18	0.37	NR
07/09/09	0.22	NR	09/18/13	0.90	NR	07/13/18	0.35	NR
08/06/09	0.60	0.10	10/09/13	1.00	NR	08/22/18	0.74	NR
09/02/09	0.35	NR	10/31/13	1.25	0.20	09/19/18	0.58	NR
10/05/09	0.49	NR	11/21/13	1.25	0.20	10/08/18	0.44	NR
11/03/09	0.53	NR	12/19/13	0.55	NR	11/19/18	0.70	NR
12/03/09	0.90	NR	02/03/14	1.30	NR	12/18/18	0.83	NR
01/06/10	1.43	NR	02/05/14	1.30	0.21	01/29/19	0.85	NR
01/13/10	1.43	0.23	02/26/14	1.03	NR	01/30/19	0.85	0.20
02/05/10	1.05	NR	03/13/14	0.65	NR	02/18/19	0.45	NR
02/22/10	1.80	0.29	04/07/14	0.88	NR	02/20/19	0.45	0.15
03/04/10	0.36	NR	04/09/14	0.88	0.14	03/11/19	0.33	NR
04/09/10	0.93	NR	05/20/14	0.55	NR	04/17/19	0.60	0.75
04/12/10	0.93	0.15	05/21/14	0.55	0.09	05/14/19	0.15	NR
05/24/10	1.10	0.18	06/11/14	0.57	0.09			
06/09/10	0.34	NR	07/17/14	0.51	NR			
07/19/10	0.78	NR	08/11/14	0.80	NR			
08/05/10	0.75	NR	09/17/14	1.30	0.21			
09/02/10	1.58	0.26	10/06/14	0.46	NR			
09/16/10	0.81	NR	11/19/14	1.22	NR			
10/12/10	1.70	0.28	12/10/14	1.20	0.20			

**Notes:**

- (1) NP - Not Present, NR - Not Removed
- (2) From 1992 to 2000, the volume of DNAPL removed was calculated as a percentage of water and DNAPL pumped from the well.  
From July 16, 2008 to August 31, 2016 the DNAPL volume removed is based on the In-well volume derived from the apparent DNAPL thickness measurement.  
Starting on August 31, 2016, the DNAPL volume removed is based on the estimated bucket volume of DNAPL removed from the well.
- (3) Well rehabilitation period via Fenton's Reagent.

**Total Gallons Removed: 13.32**

**ATTACHMENT E**  
**RECYCLING MANIFEST**



<b>UNIFORM HAZARDOUS WASTE MANIFEST</b>		1. Generator ID Number: <b>SCD987570H76</b>	2. Page 1 of <b>1</b>	3. Emergency Response Phone <b>(844) 873-8723</b>	4. Manifest Tracking Number <b>017435780 JJK</b>		
5. Generator's Name and Mailing Address <b>SOUTH CAROLINA ELECTRIC AND GAS 220 OPERATION WAY CAYCE, SC 29033-3704</b> Generator's Phone: <b>843-840-2740</b>			Generator's Site Address (if different than mailing address) <b>SOUTH CAROLINA ELECTRIC AND GAS 1/2 CHARLOTTE STREET CHARLESTON, SC 29401 818-818-2748</b>				
6. Transporter 1 Company Name <b>TRADEBE TRANSPORTATION, LLC</b>			U.S. EPA ID Number <b>INR000123497</b>				
7. Transporter 2 Company Name <b>Robbie D Wood</b>			U.S. EPA ID Number <b>ALD067138891</b>				
8. Designated Facility Name and Site Address <b>TRADEBE TREATMENT AND RECYCLING OF TN, LLC 5485 VICTORY LANE MILLINGTON, TN 39053</b> Facility's Phone: <b>901-353-5294</b>			U.S. EPA ID Number <b>TND000772188</b>				
GENERATOR	9a. HM:	9b. U.S. DOT Description (including Proper Shipping Name, Hazard Class, ID Number, and Packing Group (if any))	10. Containers No.	Type	11. Total Quantity	12. Unit Wt./Vol.	13. Waste Codes
	X	1. <b>UN3082, ENVIRONMENTALLY HAZARDOUS SUBSTANCES, LIQUID, N.O.S., 8, III, (PETROLEUM DISTILLATES, BENZENE)</b>	20	BM	1000 <del>1500</del> 210	G	none
		2.					
		3.					
		4.					
14. Special Handling Instructions and Additional Information Emergency Response Provider: <b>TRADEBE TREATMENT AND RECYCLING LLC</b> SO# <b>1950299</b> TRUCK# <b>552539</b> <b>(1)302224(9F) XDM55 ERG171 RETURN MANIFEST TO: APEX COMPANIES(ATTN: GORDON O'TOOLE) 1800 COMMERCE CIRCLE, TRAFFORD, PA 15085</b>							
15. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations. If export shipment and I am the Primary Exporter, I certify that the contents of this consignment conform to the terms of the attached EPA Acknowledgment of Consent. I certify that the waste minimization statement identified in 40 CFR 262.27(a) (if I am a large quantity generator) or (b) (if I am a small quantity generator) is true.							
Generator's/Offeror's Printed/Typed Name <b>Paul Biery</b>			Signature <i>Paul Biery</i>			Month Day Year <b>12 15 19</b>	
INTL	16. International Shipments <input type="checkbox"/> Import to U.S. <input type="checkbox"/> Export from U.S. Port of entry/exit: _____ Date leaving U.S.: _____						
	17. Transporter Acknowledgment of Receipt of Materials						
TRANSPORTER	Transporter 1 Printed/Typed Name <b>CARL JONES</b>			Signature <i>Carl Jones</i>		Month Day Year <b>12 15 19</b>	
	Transporter 2 Printed/Typed Name <b>Shin Williams</b>			Signature <i>Shin Williams</i>		Month Day Year <b>12 22 19</b>	
DESIGNATED FACILITY	18. Discrepancy						
	18a. Discrepancy Indication Space <input type="checkbox"/> Quantity <input type="checkbox"/> Type <input type="checkbox"/> Residue <input type="checkbox"/> Partial Rejection <input type="checkbox"/> Full Rejection						
	Manifest Reference Number: _____						
	18b. Alternate Facility (or Generator) _____ U.S. EPA ID Number _____						
	Facility's Phone: _____						
	18c. Signature of Alternate Facility (or Generator) _____ Month Day Year _____						
	19. Hazardous Waste Report Management Method Codes (i.e., codes for hazardous waste treatment, disposal, and recycling systems)						
	1. <b>H141</b>	2.	3.	4.			
	20. Designated Facility Owner or Operator: Certification of receipt of hazardous materials covered by the manifest except as noted in item 18a						
	Printed/Typed Name <b>JANICE WHITLEY</b>			Signature <i>Janice Whitley</i>		Month Day Year <b>12 28 19</b>	



Tradebe Environmental Services, LLC

1433 E 83rd Ave, Suite 200  
Merrillville, IN 46410  
www.tradebeusa.com

## CERTIFICATE OF WASTE MANAGEMENT

To whom this may concern

This certificate is to verify that the waste described below, is handled in accordance with local, state, and federal regulations.

Name: SOUTH CAROLINA ELECTRIC AND GAS

Address: 1/2 Charlotte Street Charleston, SC 29401

Sales Order:

Facility
TTR Millington 5485 Victory Lane Millington, TN 38053 EPA ID: TND000772186

Profile	Manifest / Page / Line	Quantity	Hc Code
302224	017435780JK 00001/001	20.000	H141

Robert O'Brien  
Executive Vice President of Operations

TRADEBE TREATMENT & RECYCLING OF TN

Date: 02/28/2019

On behalf of its subsidiary: Tradebe Treatment and Recycling, LLC

RESPONSIBLE SM  
RECYCLING  
A commitment to our generators  
our employees and our  
community.

**ATTACHMENT F**

**DNAPL MONITORING MEASUREMENTS – DECEMBER 2018 THROUGH MAY 2019**

TABLE F-1

## WEEKLY APPARENT DNAPL THICKNESS MONITORING

DESC Calhoun Park Area Site  
Charleston, South Carolina

December 2018 Through May 2019

DECEMBER					
Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
DRW-06	12/7/2018	9:40	23.40	10.85	34.25
MM-02B	12/7/2018	9:30	37.33	2.67	40.00

Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
DRW-06	12/21/2018	8:10	23.30	10.95	34.25
MM-02B	12/21/2018	8:00	37.04	2.96	40.00

JANUARY					
Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
DRW-06	1/4/2019	8:20	23.30	10.95	34.25
MM-02B	1/4/2019	8:15	37.13	2.87	40.00

Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
DRW-06	1/11/2019	8:10	23.50	10.75	34.25
MM-02B	1/11/2019	8:00	37.83	2.17	40.00

Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
DRW-06	1/25/2019	8:25	23.35	10.90	34.25
MM-02B	1/25/2019	8:00	37.90	2.10	40.00

Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
DRW-06	1/31/2019	8:45	23.30	10.95	34.25
MM-02B	1/31/2019	8:30	37.14	2.86	40.00

FEBRUARY					
Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
DRW-06	2/15/2019	8:15	23.20	11.05	34.25
MM-02B	2/15/2019	8:10	37.65	2.35	40.00

Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
DRW-06	2/21/2019	8:55	23.20	11.05	34.25
MM-02B	2/21/2019	8:50	37.35	2.65	40.00

MARCH					
Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
DRW-06	3/8/2019	8:05	23.20	11.05	34.25
MM-02B	3/8/2019	8:00	37.09	2.91	40.00

Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
DRW-06	3/14/2019	8:45	23.20	11.05	34.25
MM-02B	3/14/2019	8:40	37.68	2.32	40.00

Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
DRW-06	3/29/2019	8:10	23.40	10.85	34.25
MM-02B	3/29/2019	8:00	37.43	2.57	40.00

APRIL					
Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
DRW-06	4/4/2019	8:35	23.50	10.75	34.25
MM-02B	4/4/2019	8:15	37.80	2.20	40.00

Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
DRW-06	4/19/2019	9:10	23.10	11.15	34.25
MM-02B	4/19/2019	9:00	37.80	2.20	40.00

Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
DRW-06	4/25/2019	8:05	23.20	11.05	34.25
MM-02B	4/25/2019	8:00	37.90	2.10	40.00

MAY					
Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
DRW-06	5/9/2019	8:16	23.20	11.05	34.25
MM-02B	5/9/2019	8:14	37.45	2.55	40.00

Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
DRW-06	5/16/2019	8:10	23.30	10.95	34.25
MM-02B	5/16/2019	7:50	37.70	2.30	40.00

Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
DRW-06	5/31/2019	8:40	23.30	10.95	34.25
MM-02B	5/31/2019	8:30	37.67	2.33	40.00

**TABLE F-2**  
**MONTHLY APPARENT DNAPL THICKNESS MONITORING**

DESC Calhoun Park Area Site  
Charleston, South Carolina

December 2018 Through May 2019

**December 2018**

Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
CM-03A	12/19/2018	13:50	9.70	0.83	10.53
DRW-52C	12/18/2018	10:40	48.73	0.35	49.08
DRW-53C	12/19/2018	13:45	Trace	Trace	46.81
MM-01B	12/18/2018	10:35	56.25	0.49	56.74
MM-11A	12/18/2018	9:50	11.22	0.72	11.94
MZ-55A	12/19/2018	13:55	10.48	0.95	11.43
MW-12A	12/18/2018	10:00	17.07	0.83	17.90
DRW-48	12/18/2018	9:55	11.29	0.85	12.14
DRW-51	12/18/2018	9:58	13.53	0.28	13.81

**January 2019**

Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
CM-03A	1/29/2019	10:22	9.54	0.99	10.53
DRW-52C	1/29/2019	11:10	48.78	0.30	49.08
DRW-53C	1/29/2019	10:20	Trace	Trace	46.81
MM-01B	1/29/2019	11:00	56.45	0.29	56.74
MM-11A	1/23/2019	7:20	10.64	1.30	11.94
MZ-55A	1/29/2019	10:30	10.54	0.89	11.43
MW-12A	1/29/2019	7:50	17.05	0.85	17.90
DRW-48	1/29/2019	7:35	11.71	0.43	12.14
DRW-51	1/29/2019	7:40	13.53	0.28	13.81

**February 2019**

Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
CM-03A	2/20/2019	13:35	9.75	0.78	10.53
DRW-52C	2/18/2019	11:00	48.93	0.15	49.08
DRW-53C	2/18/2019	13:30	NP	NP	46.81
MM-01B	2/18/2019	11:10	55.44	1.30	56.74
MM-11A	2/18/2019	7:30	11.09	0.85	11.94
MZ-55A	2/20/2019	13:40	10.33	1.10	11.43
MW-12A	2/18/2019	14:10	17.45	0.45	17.90
DRW-48	2/18/2019	14:00	11.70	0.44	12.14
DRW-51	2/18/2019	14:05	13.43	0.38	13.81

**March 2019**

Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
CM-03A	3/12/2019	9:48	9.73	0.80	10.53
DRW-52C	3/12/2019	10:30	Trace	Trace	49.08
DRW-53C	3/12/2019	9:45	Trace	Trace	46.81
MM-01B	3/12/2019	10:35	56.81	0.13	56.74
MM-11A	3/11/2019	8:50	10.94	1.00	11.94
MZ-55A	3/12/2019	9:53	10.73	0.70	11.43
MW-12A	3/11/2019	9:00	17.57	0.33	17.90
DRW-48	3/11/2019	8:55	11.66	0.48	12.14
DRW-51	3/11/2019	8:58	13.43	0.38	13.81

**April 2019**

Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
CM-03A	4/23/2019	10:20	9.90	0.63	10.53
DRW-52C	4/23/2019	11:30	48.78	0.30	49.08
DRW-53C	4/23/2019	10:10	Trace	Trace	46.81
MM-01B	4/23/2019	11:25	Trace	Trace	56.74
MM-11A	4/22/2019	8:30	11.12	0.82	11.94
MZ-55A	4/23/2019	10:35	10.38	1.05	11.43
MW-12A	4/17/2019	9:30	17.30	0.60	17.90
DRW-48	4/22/2019	13:33	11.76	0.38	12.14
DRW-51	4/22/2019	13:35	13.41	0.40	13.81

**May 2019**

Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
CM-03A	5/14/2019	11:55	9.85	0.68	10.53
DRW-52C	5/14/2019	10:15	47.89	1.19	49.08
DRW-53C	5/14/2019	12:15	NP	NP	46.81
MM-01B	5/14/2019	10:10	Trace	Trace	56.74
MM-11A	5/14/2019	8:20	10.76	1.18	11.94
MZ-55A	5/14/2019	14:00	10.24	1.19	11.43
MW-12A	5/14/2019	8:25	17.72	0.18	17.90
DRW-48	5/14/2019	8:30	11.63	0.51	12.14
DRW-51	5/14/2019	8:35	13.50	0.31	13.81

TABLE F-3

## QUARTERLY APPARENT DNAPL THICKNESS MONITORING

DESC Calhoun Park Area Site  
Charleston, South Carolina

December 2018 Through May 2019

## FIRST QUARTER 2019

Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
DRW-02	1/11/2019	8:15	26.40	0.15	26.55
DRW-07	1/11/2019	8:20	Trace	Trace	31.95
DRW-08	1/8/2019	11:43	14.35	0.39	14.74
DRW-09	1/8/2019	11:45	Trace	Trace	11.69
DRW-12	1/3/2019	7:50	13.98	0.50	14.48
DRW-13	1/7/2019	10:50	15.35	0.92	16.27
DRW-14	1/8/2019	8:51	12.07	0.28	12.35
DRW-15	1/8/2019	8:47	13.19	0.33	13.52
DRW-16	1/8/2019	8:48	13.62	0.26	13.88
DRW-17	1/8/2019	8:49	10.93	0.28	11.21
DRW-18	1/8/2019	8:50	12.74	0.23	12.97
DRW-19	1/8/2019	8:39	13.20	0.64	13.84
DRW-20	1/8/2019	8:37	14.65	0.18	14.83
DRW-21	1/7/2019	7:40	15.28	0.62	15.90
DRW-22	1/8/2019	8:22	12.70	0.47	13.17
DRW-23	1/8/2019	8:28	14.73	0.20	14.93
DRW-24	1/7/2019	8:03	15.67	0.19	15.86
DRW-25	1/8/2019	8:35	14.88	0.13	15.01
DRW-26	1/8/2019	13:26	12.70	0.23	12.93
DRW-27	1/8/2019	13:35	Trace	Trace	12.90
DRW-28	1/7/2019	8:04	13.60	0.18	13.78
DRW-29	1/8/2019	13:28	NP	NP	12.08
DRW-30	1/8/2019	13:28	15.08	0.19	15.27
DRW-31	1/8/2019	13:36	Trace	Trace	15.07
DRW-32	1/7/2019	8:00	17.03	0.77	17.80
DRW-33	1/8/2019	10:30	15.90	0.41	16.31
DRW-34	1/9/2019	7:40	16.93	0.42	17.35
DRW-35	1/9/2019	7:50	15.60	0.46	16.06
DRW-36	1/8/2019	8:12	14.61	0.14	14.75
DRW-37	1/8/2019	8:15	14.53	0.37	14.90
DRW-38	1/8/2019	8:10	16.78	0.18	16.96
DRW-39	1/7/2019	8:05	15.10	0.20	15.30
DRW-40	1/8/2019	13:24	14.61	0.21	14.82
DRW-41	1/8/2019	13:23	16.41	0.70	17.11
DRW-42	1/8/2019	8:00	16.50	0.36	16.86
DRW-45	1/9/2019	13:29	15.59	0.14	15.73
DRW-46	1/9/2019	13:30	14.87	0.11	14.98
DRW-47	1/9/2019	13:25	16.08	0.25	16.33
DRW-49	1/10/2019	7:30	NP	NP	11.05
DRW-50	1/10/2019	7:31	Trace	Trace	9.73
A3-T3	1/10/2019	7:35	8.88	0.15	9.03
MM-15C	1/10/2019	11:10	Trace	Trace	50.90
MRW-05	1/8/2019	13:45	NP	NP	15.22
MZ-06M	1/10/2019	11:15	Trace	Trace	8.44
ORC-7	1/10/2019	7:38	Trace	Trace	8.62

## NOTES:

NP- Not Present

NM- Not Measured

TRACE-Trace



TABLE F-3

## QUARTERLY APPARENT DNAPL THICKNESS MONITORING

DESC Calhoun Park Area Site  
Charleston, South Carolina

December 2018 Through May 2019

## SECOND QUARTER 2019

Well ID	Date	Time	Depth to DNAPL (ft)	DNAPL Thickness (ft)	Total Depths (ft)
DRW-02	4/25/2019	8:07	Trace	Trace	26.55
DRW-07	4/25/2019	8:28	Trace	Trace	31.95
DRW-08	4/22/2019	8:52	Trace	Trace	14.74
DRW-09	4/22/2019	8:51	Trace	Trace	11.69
DRW-12	4/16/2019	8:20	14.10	0.38	14.48
DRW-13	4/22/2019	8:44	15.89	0.38	16.27
DRW-14	4/22/2019	8:44	12.06	0.29	12.35
DRW-15	4/18/2019	7:40	13.24	0.28	13.52
DRW-16	4/22/2019	8:45	13.71	0.17	13.88
DRW-17	4/22/2019	8:45	10.93	0.28	11.21
DRW-18	4/22/2019	8:46	12.72	0.25	12.97
DRW-19	4/18/2019	10:00	13.56	0.28	13.84
DRW-20	4/22/2019	8:47	14.70	0.13	14.83
DRW-21	4/15/2019	11:00	15.01	0.89	15.90
DRW-22	4/22/2019	8:41	12.90	0.27	13.17
DRW-23	4/22/2019	8:40	Trace	Trace	14.93
DRW-24	4/22/2019	10:20	15.64	0.22	15.86
DRW-25	4/22/2019	8:48	14.82	0.19	15.01
DRW-26	4/22/2019	12:12	12.76	0.17	12.93
DRW-27	4/22/2019	10:12	Trace	Trace	12.90
DRW-28	4/22/2019	10:13	13.57	0.21	13.78
DRW-29	4/22/2019	10:14	Trace	Trace	12.08
DRW-30	4/22/2019	10:15	15.08	0.19	15.27
DRW-31	4/22/2019	10:16	14.99	0.08	15.07
DRW-32	4/19/2019	9:45	17.44	0.36	17.80
DRW-33	4/16/2019	7:40	15.80	0.51	16.31
DRW-34	4/18/2019	7:30	16.62	0.73	17.35
DRW-35	4/22/2019	10:21	15.20	0.86	16.06
DRW-36	4/22/2019	10:21	14.61	0.14	14.75
DRW-37	4/22/2019	10:21	14.72	0.18	14.90
DRW-38	4/22/2019	10:22	16.69	0.27	16.96
DRW-39	4/22/2019	10:20	15.11	0.19	15.30
DRW-40	4/22/2019	10:20	14.63	0.19	14.82
DRW-41	4/16/2019	10:25	16.72	0.39	17.11
DRW-42	4/22/2019	8:20	16.43	0.43	16.86
DRW-45	4/22/2019	10:17	15.61	0.12	15.73
DRW-46	4/22/2019	10:18	14.88	0.10	14.98
DRW-47	4/22/2019	10:19	16.13	0.20	16.33
DRW-49	4/22/2019	13:34	NP	NP	11.05
DRW-50	4/22/2019	13:35	9.62	0.11	9.73
A3-T3	4/22/2019	14:14	8.78	0.25	9.03
MM-15C	4/23/2019	10:15	Trace	Trace	50.90
MRW-05	4/22/2019	10:55	NP	NP	15.22
MZ-06M	4/23/2019	10:30	Trace	Trace	8.44
ORC-7	4/22/2019	13:39	Trace	Trace	8.62

NP- Not Present  
 NM- Not Measured  
 TRACE-Trace

**TABLE F-4****ANNUAL APPARENT DNAPL THICKNESS MONITORING**

**DESC Calhoun Park Area Site  
Charleston, South Carolina**

**Measurement Year 2019**

<b>Well ID</b>	<b>Date</b>	<b>Time</b>	<b>Depth to DNAPL (ft)</b>	<b>DNAPL Thickness (ft)</b>	<b>Total Depths (ft)</b>
DRW-10	4/22/2019	8:50	NP	NP	9.32
DRW-11	4/22/2019	8:51	NP	NP	8.81
LM-09B	4/25/2019	7:20	NP	NP	32.62
LM-10AR	4/22/2019	11:00	Trace	Trace	12.12
MM-03A	4/25/2019	8:37	Trace	Trace	13.40